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European Journal of Underwater and Hyperbaric Medicine

EUBS European Underwater and Baromedical Society

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CIRCULATION of this issue: 1000

EUBS EXECUTIVE COMMITTEE

EDITORIAL

Dear friends and colleagues,

it gives me great pleasure to welcome you in sunny Sharm el-Sheikh.

The 33rd scientific meeting of the EUBS promises to be a very special event, setting maybe the pace for others to come. The scientific program is rich and multifaceted and the organization was sometimes a real challenge! Innovation and creativity helped us. For the first time I extended an invitation to dive professionals to join us during the sessions that interest them and this way we might have lively panel discussions. Diving in our warm clear water is also integrated in the program and will extend over one and a half days. Our dinners will not be conventional most of the time. Hopefully you leave taking with you the spirit of Sinai.

I wish you all a great week and hope to see you you in Sharm el-Sheikh again and again and again....

Adel Taher
Secretary General EUBS ASM 2007

EUBS GENERAL ASSEMBLY 2006

The president N. Bitterman welcomes the members.

The minutes of the general assembly 2005 in Barcelona and the financial and membership status of the society are approved. Due to the insufficient payment morality of some members the society has no financial reserve. Members are urged to pay rapidly their membership fee. The website of the society will allow electronic payment in the near future. The new fees, which have been voted 2005, will be requested according to the bylaws, starting on July 1st.

Members: 55 Euros, students: 27, 5 Euros, corporate members: 300 Euros. Members having not paid their annual membership fee will not be allowed the congress membership discount. Congress organizers will cross check with the actual membership payment status.

The editor of EJUHM, P. Müller is asking for more quality papers. The joint venture planned with the Australian SPUMS journal could not yet be realized. Partially due to the difficult financial status of the society, discussion is raised on the opportunity to have the journal only on line. Since the journal has actually no impact factor, this electronical version should be kept on the unprotected area in order to be better distributed in the scientific community. Arguments against this are the wish of many members to have a paper copy for their library and travel purpose. Proceedings resembling increasingly to a collection of abstracts instead of a real text proceedings, all members presenting a scientific communication at the congresses are urged to send full papers instead of abstracts. If this cannot be achieved, it would be possible for the editor of the journal to approach the authors of promising abstracts and asked them for an extended version in order to support the journal. To increase the value of the journal a peer review committee should be created.

The web master P. Germonpré, informs that there have been a change of server resulting in financial saving for the society. A secured area allowing on line payment and including an updated membership directory should be operational by the start of 2007. The introduction of electronic voting for the election of society's officers or other important matters is suggested to the general assembly. The suggestion is voted unanimously and should be available by simple email for next year. Members are requested to send their email address as soon as possible to Coppernob@freewire.co.uk in order to allow the process to start. It is suggested that Proceedings should also be available electronically on the website starting one year after the congress has been held but no decision is taken. A motion presented by A. Taher recommending including links to other scientific societies on the website with the condition of reciprocity is voted unanimously by he members.

The Bergen congress was well attended, according to its general secretary; A. Hope there were 220 participants, of which 186 were active delegates, 5 Exhibitors and 29 accompanying persons. 6 student grants of 250 Euros each have been attributed by the society and topped up to 350 Euros by the local organizing committee. Congress balance will probably be even so that a society's loan will not be requested. The president congratulates the organizers for an excellent and friendly organization.

The society's books have been revised and accepted in UK by the reviser D. Moran DDRC.

The Zetterström award, attributed to J. H. Abrani will be presented to the authors as a new gold printed diploma. The original work will be published integrally in the journal. The updated membership directory compiled by T. Woodings and P. Müller has been distributed to the members.

C. Ballestra has ended his 3 year term as a member at large and will leave the executive committee. He will be replaced by the new elected one: M. Cimsit.

G. Bolstad who was president of the EUBS from 1998 to 2001 his also finishing her 12 year term in the executive committee. The president thanks Greta for her continuing dedication to the society. Normally the excom should have presented the candidature of a new vice president to replace G. Bolstad. Unfortunately this has been forgotten. According to the by laws, this can only be done 6 months before a general assembly so that it will be only be possible for next year. In the mean time, N. Bitterman agrees to serve as a replacement in case of unexpected incapacity of the new president A. Brubback. The members are asked to submit proposals for a new vice president and member at large for 2007. Proposals should be directed to A. Brubback.

A. Taher makes some complements to the leaflet of the 1st announcement of the 2007 meeting in Sharm el Sheick. In particular he says that he is in the position to give the congress discount rate to all members who want to stay longer than the duration of the meeting. Interested members should contact him directly.

Next meetings: 2007 Sharm el Sheik, 2008 Graz, 2009 Aberdeen, 2010 Greece.

N. Bitterman closes her presidential term and hands out the presidency to A. Brubback. As first statement, A. Brubback warmly congratulates and thanks N. Bittermann for her strong engagement and hands her a present in the name of all the members.

A. Brubback closes the general assembly and encourages all members to come next year to Egypt.

Jörg Schmutz, Secretary

EUBS FIANCIAL STATEMENT 2006

FINANCIAL STATEMENT JANUARY 2006 TO DECEMBER 2006 - Sterling Account

Bank Balance as at 1st January 2006	£	1'569.01	**£**	**1'569.01**
Petty Cash at 1st January 2006	£	99.44		
Income				
Membership Fees	£	7'878.46		
Journal Advertising	£	300.00		
Bank Interest/Refunds	£	1'091.02		
			£	**9'269.48**
Expenditure				
Secretarial Fees	£	600.00		
Cardnet/Bank Charges	£	796.00		
Petty Cash for Postage/ Stationery/Copying	£	400.00 (Includes s.a.e. and postage for ballot)		
Telephone/Fax/Sundries	£	-		
Presentation Gift - AGM 2006	£	32.72		
Travel Grants - Meeting 2006	£	1'378.93		
Travel/Hotel Expenses Treasurer - Meeting 2006	£	497.65		
Journal Expenses - March 06 Issue	£	1'015.23		
Journal Expenses - June 06 Issue	£	2'134.31		
Journal Expenses - September 06 Issue	£	2'666.77		
			-£	**9'521.61**
Closing Bank Balance as at 31st December 2006	£	1'316.88		
Petty Cash in Hand	£	25.73		
			£	**1'316.88**

FINANCIAL STATEMENT JANUARY 2006 TO DECEMBER 2006 - Euro Account

Bank Balance as at 1st January 2006			**€**	**1'195.18**
Income				
Membership Fees	€	2'653.60		
Journal Advertising	€	424.66		
Extra Journals - P Knessl	€	719.38		
Bank Interest	€	-		
			€	**4'992.82**
Expenditure				
Bank Charges	€	180.10		
Travel Grant - Meeting 2005	€	600.00		
Journal Expenses - December 05 Issue	£	1'414.11		
			-€	**2'194.21**
Closing Bank Balance as at 31st December 2006	(Approximately = £1,903.81)		**€**	**2'798.61**
Total Balance of both accounts as at 31st December 2006			**£**	**3'220.69**

Please notice that the accounts have not been audited yet!

PROGRAM OF THE 33rd EUBS ANNUAL SCIENTIFIC MEETING

Saturday, September 8

14	00	Registration Desk	
19	00	Welcome Reception	

Sunday, September, 9

09	00	Opening by Dr. Adel Taher & H.E. General Hany Metwally, the Governor of South Sinai	
09	15	H.E. Dr. Hatem Elgabaly - Minister of Health	
09	30	H.E. Mohamed Zoheir Garana = Minister of Tourism	
09	45	Official Speeches	Taher
10	00	Break	
10	15	**Invited Lecturer: to be announced**	**N. N.**
10	45	O 1 EXPERIMENT ON "THERMONEUTRALITY LONG DURATION IMMERSION"	Robinet
10	55	O 2 ROLE OF NMDA AND GABAa RECEPTORS IN THE REVERSAL EFFECT OF REPETITIVE EXPOSURES TO NITROGEN NARCOSIS ON STRIATAL DOPAMINE LEVEL	Lavoute
11	05	O 3 WHERE DO BUBBLES FORM?	Mollerlokken
11	15	O 4 DESIGN OF AN UNDERWATER TELEMETRIC SYSTEM FOR REBREATHERS	Egi
11	30	Coffee Break & Poster Viewing	
12	10	O 5 SAFETY AND DESIGN OF HYPERBARIC DEEP DIVE SEMINARS	Renner
12	20	O 6 NATURAL FREQUENCY OF THE IMMERSED HUMAN LUNG	Fothergill
12	30	O 7 4 MONTHS OF INTENSIVE SCUBA DIVING REDUCED BUBBLE FORMATION WITH NO CHANGE IN ENDOTHELIAL FUNCTION	Pontier
12	40	O 8 PROTECTIVE EFFECT OF A 2-HOURS PRE-DIVE EXERCISE ON BUBBLE FORMATION: PART OF EXERCISE INTENSITY	Pontier
12	50	O 9 DOES THE VO2maxVALUE PREDICT THE FORMATION OF INTRAVASCULAR CIRCULATING BUBBLES DURING DECOMPRESSION OF HEALTHY DIVERS?	Castagna
13	00	Panel Discussion	
13	30	Lunch Break	
15	00	**Invited Lecturer: EXERCISE & DIVING**	**Andreas Møllerløkken**
15	30	O 10 PERSONAL CHARACTERISTICS OF SPORTS DIVERS: A QUASI-EXPERIMENTAL STUDY	Paterok, Schipke
15	40	O 11 LUNG FUNCTION IN A COHORT OF SCUBA DIVERS	Wilson
15	50	O 12 ASSESSING FITNESS TO RETURN TO DIVING AFTER DECOMPRESSION ILLNESS AND FOLLOW-UP EXAMINATIONS	Fabricius
16	00	O 13 EMERGENCY FREE ASCENT AS A CAUSE OF PULMONARY BAROTRAUMAS. A RETROSPECTIVE STUDY OF 10 YEARS OF TREATMENT OF DIVE TRAINING (IN-WATER SKILLS) RELATED INJURIES	Lafère
16	10	O 14 A PILOT SURVEY OF ALCOHOL CONSUMPTION AMONG PROFESSIONALS IN SHARM-EL-SHEIKH	Taher
16	20	Coffee Break & Poster Viewing	
16	50	O 15 DO BUBBLE GRADES DIFFER AFTER A FIRST AND IDENTICAL REPETITIVE DIVE WITHOUT AEROBIC SPORT DURING THE PRECEEDING DAY?	Schellart
17	00	O 16 Mg^{2+} AND AP-5 BLOCKADE OF NMDA RECEPTOR IN HIPPOCAMPAL RAT BRAIN SLICES IS INHIBITED BY HYPERBARIC PRESSURE	Mor
17	10	O 17 MULTIFREQUENCY BIOIMPEDENCE ANALYSIS TO ASSES THE DEHYDRATION RELATED TO DIVING	Egi
17	20	Poster Viewing	
17	40	Panel Discussion	
18	15	Stargazing Dinner in the Desert	

Monday, September, 10

08	00	Scuba Diving and Snorkeling	
15	00	**Invited Lecturer: Spinal Injuries**	**Armin Kemmer**

15	30	O 18 EMBOLISM OF THE SPINAL CORD AND DECOMPRESSION SICKNESS	James
15	40	O 19 UNDER-ICE RESEARCH: THE INTERNATIONAL POLAR DIVING WORKSHOP	Lang
15	50	O 20 EFFECT OF A SINGLE POOL DIVE ON PULMONARY FUNCTION IN ASTHMATIC AND NON ASTHMATIC DIVERS	Ivkovic
16	00	O 21 THE TECHNICAL ERA; CASE REPORT	Taher
16	10	Coffee Break & Poster Viewing	
16	50	Panel Discussion	
17	25	*Lecture on Ras Mohamed National Park and conservation efforts*	
20	00	Dinner at Turquoise Beach	

Tuesday, September, 11

09	00	**Invited Lecturer: Physiology of HBOT**	**Stephen R. Thom**
09	30	O 22 HYPERBARIC OXYGEN TREATMENT FOR ACUTE ISCHEMIC STROKE. A RANDOMIZED SINGLE-BLINDED CASE-CONTROL STUDY AT START	Michalski
09	40	O 23 HYPERBARIC OXYGEN THERAPY IN DIFFERENT STROKE MODELS IN RATS	Kueppers-Tiedt
09	50	O 24 THE ROLE OF HYPERBARIC MEDICINE IN THE EMERGENCY MEDICINE SYSTEM IN POLAND	Sokolowski
10	00	O 25 USEFULNESS OF HYPERBARIC OXYGENATION AS SUPPORTIVE THERAPY OF HEMORRHAGIC CYSTITIS	Sokolowski
10	10	O 26 DYSBARIC OSTEONECROSES IN SPONGE-DIVERS OF KALYMNOS ISL.	Liolios
10	20	O 27 COST B14 STUDY ON HBO AND SUDDEN DEAFNESS - UPDATE AND REVIEW OF THE INCLUSION CRITERIA	Germonpré
10	30	Coffee Break & Poster Viewing	
11	00	O 28 FROSTBITE AND HBOT: BENEFIT OF DELAYED TREATMENT	Vujnovice
11	10	O 29 ECONOMIC IMPACT ON HOSPITALIZATION OF HBO THERAPY WITHIN A COMMUNITY OUTPATIENT WOUND CARE CENTER	Longobardi
11	20	O 30 SALIVATORY SECRETION RATE BEFORE AND AFTER HYPERBARIC OXYGEN TREATMENT IN IRRADIATED PREVIOUSLY HEAD AND NECK CANCER PATIENTS	Jansen
11	30	O 31 ACUTE CARBON MONOXIDE POISONING DURING PREGNANCY. MATERNAL AND FETAL OUTCOME	Mathieu-Nolf
11	40	O 32 HYPERBARIC OXYGEN TREATMENT IN COMBINATION WITH THROMBOLYSIS IN ISCHEMIC STROKE PATIENTS - RESULTS FROM A PROSPECTIVE PILOT STUDY	Michalski
11	50	O 33 HYPERBARIC ARGON	Ruzicka
12	00	EUBS 2008, Graz, Austria	B. Ratzenhofer
12	10	Panel Discussion	
12	40	Poster Viewing	
13	00	**EUBS General Assembly**	
13	30	Lunch Break	
14	30	**Invited Lecturer: HBO Evidence Based Medicine**	**Michael Bennett**
15	00	O 34 MANAGEMENT OF PATIENTS WITH NECROTIZING SOFT TISSUE INFECTIONS AT SAHLGRENSKA UNIVERSITY HOSPITAL	Fabricius
15	10	O 35 HYDROGEN SULFIDE POISONING AND HYPERBARIC OXYGEN THERAPY	Jansen
15	20	O 36 RADIAL ARTERIAL AND CENTRAL VENOUS PRESSURE PROFILES IN VENTILATED INTENSIVE-CARE PATIENTS DURING HBO THERAPY	Ratzenhofer-Komenda
15	30	O 37 NORMOBARIC OXYGEN PARADOXON	Balestra
15	40	O 38 ENDOTHELIAL CONSTITUTIVE NITRIC OXIDE PRODUCTION PROTECTS AGAINST HYPERBARIC PULMONARY OXYGEN TOXICITY	Atochin
15	50	Coffee Break & Poster Viewing	
16	30	O 39 RATING OF THE SATISFACTION FACTOR IN PATIENTS TREATED AT A CLINICAL HYPERBARIC CENTER: THE QUESTIONNAIRE AT COMPLETION OF TREATMENT	Houman
16	40	O 40 INITIAL AND CONTINUOUS EDUCATION AND TRAINING FOR HYPERBARIC CENTRE PERSONNEL	McKenna
16	50	Poster Viewing	

17	30	Panel Discussion	
18	00	*Lecture on Bedouin tribes, traditions and tribal law*	Alberto Sileotti
20	00	Bedouin Dinner	

Wednesday, September, 12

09	00	**Invited Lecturer: ENT PROBLEMS AND DIVING**	**Christoph Klingmann**
09	30	O 41 GENDER IN RELATION TO INCIDENCE AND RISK FACTORS FOR DIVING-RELATED SYMPTOMS OF EAR AND SINUS AMONG DIVEMASTERS AND INSTRUCTORS	Hagberg
09	40	O 42 HUMAN STUDIES ON DIVE RELATED CHANGES IN COCHLEAR FUNCTION	Casella
09	50	O 43 EFFICIENCY OF HYPERBARIC OXYGEN THERAPY IN ACUTE ACOUSTIC TRAUMA FROM FIREARMS. A PROSPECTIVE STUDY OF ONE YEAR OF TREATMENT IN MILITARY HOSPITAL "QUEEN ASTRID"	Lafère
10	00	O 44 ACUTE ACOUSTIC TRAUMA TREATED FROM 2004 TO JUNE 2007 BY HYPERBARIC OXYGEN THERAPY IN WARSAW HYPERBARIC CENTER	Piechocki
10	10	O 45 DIFFERENCE IN BUBBLE FORMATION USING DEEP STOPS IS DEPENDENT ON BOTTOM TIME; EXPERIMENTAL FINDINGS AND THEORETICAL SUPPORT	Gutvik
10	20	O 46 EFFECT OF A DEEP STOP ON VGE BUBBLES AFTER A 20 MSW DIVE	Schellart
10	30	Coffee Break & Poster Viewing	
11	30	O 47 HOW SAFE ARE "ACCEPTED" TABLES? SIGNIFICANT INCREASE IN BUBBLE FORMATION IN-WATER	Brubakk
12	00	Panel Discussion	
13	00	**SATELLITE MEETINGS, see separate program**	
21	00	Gala Dinner at the Hyatt	

Thursday, September, 13

Free

Friday, September, 14

09	00	**Invited Lecturer: Apnoe**	**Claus Muth**
09	30	O 48 LUNG VOLUME AND DIVING PERFORMANCE IN ELITE APNEISTS	Schagatay
09	40	O 49 DIVING RESPONSE AND ARTERIAL OXYGEN SATURATION DURING APNEA IN APNEISTS AND UNTRAINED SUBJECTS OF BOTH GENDERS	Schagatay
09	50	O 50 SPLEEN SIZE AND DIVING PERFORMANCE IN ELITE APNEISTS	Schagatay
10	00	O 51 DIVING AND HYPERBARIC MEDICINE - A JOURNAL FOR BOTH SPUMS & EUBS?	Michael Davis & Peter Mueller
10	30	Coffee Break & Poster Viewing	
11	00	O 52 SPLEEN CONTRACTION AT 2 MIN APNEA AND 20 MIN HYPOXIC BREATHING	Lodin
11	10	O 53 SPLEEN CONTRACTION DURING APNEA IN DIVERS AND NON DIVERS OF BOTH GENDERS	Lodin
11	20	O 54 THE SINGLE BREATH DIFFUSING CAPACITY BEFORE AND IMMEDIATELY AFTER A BREATH HOLD DIVING TO 30 METERS UNDERSEA	Bedini
11	30	O 55 THE DIVING RESPONSE: CAN THE REDUCTION IN HEART RATE BE DESCRIBED USING A SIMPLE MATHEMATICAL FUNCTION?	Schipke
11	50	Panel Discussion	
12	30	Lunch Break ***EUBS EXCOM side meeting***	
14	00	HOW TO DIVE TO 214m… AND SURVIVE	Herbert Nitsch
14	30	Hyberbaric Medical Center, Sharm el-Sheikh, Sinai, Statistics 1	Taher/Welslau
14	40	Hyberbaric Medical Center, Sharm el-Sheikh, Sinai, Statistics 2	Taher/Welslau
14	50	Alf Brubak, EUBS President addresses the conference	
15	00	Awards Presentation	
15	10	Closing Remarks and FAREWELL	

POSTERS

P 1	USE OF A RESCUE VENTILATOR AS DEMAND VALVE	Andel, D.
P 2	USE OF A RESCUE VENTILATOR UNDER IIYPERBARIC CONDITIONS	Andel, H.
P 3	A NEW LOOK AT DIVE COMPUTERS	Angelini
P 4	SEVERE MYOCARDIAL DYSFUNCTION AFTER PROLONGED EXPOSURE TO CARBON MONOXIDE: A POSSIBLE CASE OF TAKOTSUBO CARDIOMYOPATHY	Baert
P 5	4 MONTHS OF INTENSIVE DIVING AND EXERCISING: INFLUENCE ON RIGHT-TO-LEFT SHUNTING	Blatteau
P 6	DECOMPRESSION ILLNESS AND ROTATOR CUFF DISEASE: REPORT OF A CASE SEEN BY OTHER SPECIALISTS & CONTROVERSIES REGARDING THE APPROACH	Chandrinou
P 7	HYPERBARIC OXYGEN THERAPY IN FOURNIER´S GANGRENE AS COMPLICATION OF PREOPERAT1VE RADIOTHERAPY; A CASE REPORT	Cimsit, Korpinar
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P 9	RISK ESUMATES OF OXYGEN TOXIC1TY DURING DISSUB ESCAPES FROM 600 TO 1000 FT	Connor, Ferrigno
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P 12	THRESHOLD FOR LUNG VIBRATION IN DIVERS EXPOSED TO LOW FREQUENCY UNDERWATER SOUND	Fothergill
P 13	FIRST AID OXYGEN IN DIVING ACCIDENTS IN BELGIUM	Galicia
P 14	PREVENTIVE EFFECT OF PRE-DIVE HYDRATION ON BUBBLE FORMATION AFTER OPEN-SEA DIVES	Gempp
P 15	OXIDATIVE STRESS IN GERMAN COMBAT SWIMMERS AND UDT DIVERS: EVIDENCE FOR ADAPTATION	Gröger
P 16	DIVING - AN OPTIONAL THERAPY AGAINST SPASTICITY IN PARAPLEGICS	Haydn
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P 18	BRAIN PERFUSION CIIANGES AFTER HYFERBARIC OXYGEN T1IERAPIIY IN THE CHILDREN WITII AUTISM	Kinaci
P 19	LEFT VENTRICULAR DIASTOLIC FUNCTION CHANGES DURING BREATHHOLD DIVING IN HUMANS	Marabotti, Bedini
P 20	BAROTRAUMATIC ORBITAL EMPHYSEMA IN BREATHOLD DIVER	Marcolin
P 21	COMPARISON OF FINGER SKIN TEMPERATURE CHANGES DURING IMMERSION IN FOUR DIFFERENT WATER TEMPERATURES	Mekjavic
P 22	DCS OF ARTERIAL ORIGIN - A POSSIBLE IMPOSSIBILITY IN NO LIMITS BREATH-HOLD DIVING?	Muth
P 23	EMPIRICAL CLASSIFICATION OF DCS PATIENTS USING CLUSTER ANALYSIS	Ozyigit
P 24	CHANGES IN CARBONYL PROTEIN LEVELS DURING A ONEWEEK DIVING TRIP	Pokorny, Renner
P 25	CHANGES IN BLOOD PLATELET COUNT AFTER DECOMPRESSION AND CORRELATION WITH BUBBLE FORMATION	Pontier
P 26	A CASE REPORT OF RECURRENT ACUTE PULMONARY OEDEMA IN RECREATIONAL DIVER	Rodofili
P 27	ANALYSIS OF THE OXYGEN IN MASK	Ruggiu
P 28	PULMONARY EDEMA IN HYPERTENSIVE SCUBA DIVERS: CASE REPORT	Sakr
P 29	A COMPARATIVE INVESTIGATION OF THE PERFORMANCE, RELIABILITY AND SAFETY OF DIVE COMPUTERS WITH AIR-DIVES	Schellart
P 30	AN EXTENSION OF THE BUIILMANN / WORKMAN-MODEL FOR APNOE DIVING	Schipke
P 31	CCR SAFETY: PO2 SENSOR SIGNAL VALIDATION	Sieber
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P 33	HBOT FOR MUSCLE INJURY IN PROFESSIONAL ATHLETES	Simon
P 34	ITU PARAMETERS IN NECROTISING SOFT TISSUE INFECTIONS ARE UNAFFECTED BY HYPERBARIC OXYGEN: AN ADULT ITU AUDIT ON 15 PATIENTS 1996-2005	Sykes
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P 37	COMBINATION OF HYPERBARIC OXYGEN THERAPY AND NEGATIVE PRESSURE WOUND THERAPY IN THE MANAGEMENT OF DIABETIC WOUNDS	Uzun
P 38	DOES THE CALCULATED MAXIMAL OXYGEN UPTAKE REFLECT THE MEASURED MAXIMAL UPTAKE CORRECTLY?	van Ooij
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ANNOUNCEMENT

The Hyperbaric Research Prize has been introduced to further encourage the scientific advancement of hyperbaric medicine. **The Hyperbaric Research Prize** will recognize a scholarly published work or body of work(s) either as original research or as a significant advancement in the understanding of earlier published science. The scope of this work includes doctoral and post-doctoral dissertations. The Foundation does not preclude the nomination of individuals who have been awarded other prizes and honors for this same research. **The Hyperbaric Research Prize** will be awarded annually whenever a suitable nominee is identified.

The Hyperbaric Research Prize is international in scope. The awardee may reside or work in any country in the world. However, the research must be available in English to the Foundation's Nominations Review and Awards Committees.

The Hyperbaric Research Prize takes the form of commissioned art piece and US$ 10,000.00 honorarium. Candidates will have produced, within three years of their nomination, research that:

1) Identifies important basic mechanisms supporting the existing uses or potentially new uses of hyperbaric oxygen therapy
2) Results in the elevation of hyperbaric oxygen therapy to Level 1 evidence of efficacy for a given condition
3) Represents ground-breaking clinical findings related to new applications of hyperbaric oxygen therapy

Further information is available from:

Baromedical Research Foundation
5 Medical Park
Columbia, SC 29203
Telephone: 803.434.7101 Fax: 803.434.4354
Email: samir.desai@palmettohealth.org

ABSTRACTS OF THE 33rd EUBS ANNUAL SCIENTIFIC MEETING

O 1 EXPERIMENT ON "THERMONEUTRALITY LONG DURATION IMMERSION"

C. Robinet[1], F.M. Galland[1], A. Boussuges[1], A.V. Desruelle[1], Y. Jammes[2], C. Jimenez[3], B. Melin[3], L. Mourot[4], J. Regnard[4], F. Riera[1], B. Schmid[1].

[1]IMNSSA – Institut de Médecine Navale, BP 610, 83800 Toulon Armées, [2]Institut Jean Roche, Faculté de médecine, Université de la Méditerranée, 13000 Marseille, [3]CRSSA – Centre de recherche du service de santé des armées, BP 87, 38702 La Tronche, [4]Laboratoire de physiologie et d'explorations fonctionnelles, Faculté de médecine de Besançon, 25030 Besançon - France

This second «Long duration immersion» experiment took place under the scientific management of the Institute of Naval Medicine which co-ordinated seven civilian and military scientific teams.

Objective: The aim of the study was to evaluate the tolerance of long duration Seals Delivery Vehicles (SDV) missions in thermo neutrality water and make the difference between the effects of cold (cf previous experiment) and those of the immersion itself.

Methods: Each of ten well-trained combat swimmers performed a static six hours total body immersion in a temp.-regulated swimming pool at 34.5°C, wearing bathing trunks. Five among the 10 divers had participated to the previous cold experiment at 10°C. Original data collection (blood samples, core and skin temperatures, electrocardiogram, electromyogram) made possible the study of the effects of immersion on major physiological functions and the comparison to the occurrence of hypothermia.

Results: All the divers tolerated the experiment without medical problem. Core temperature stayed at 37°C, confirming the perfect thermo neutrality. Mean skin temperature stayed around water temperature. The maximal voluntary contraction and the endurance time to fatigue were not affected. Neuromuscular transmission was smoothly altered. Electromyogram showed fatigue signs after 3 hours without modifications of lactate or potassium. The M wave was modified in the way of hyper excitability. Mental performances stayed correct on these elite divers. A potentially dangerous post-immersion dehydration with plasmatic and iso-osmotic hypovolemia was observed. It was similar to the dehydration observed in cold conditions but happened on a different way. We confirm here that the adaptation to hypovolemia is delayed compared to the cold condition. This hypovolemia, confirmed by echocardiography and blood analysis, was still present the next morning, certainly impairing the possibility of another mission. Re-hydration with salted drinks is recommended.

Conclusions: Caution is advised for operational missions, warm or cold water alike.

O 2 ROLE OF NMDA AND $GABA_A$ RECEPTORS IN THE REVERSAL EFFECT OF REPETITIVE EXPOSURES TO NITROGEN NARCOSIS ON STRIATAL DOPAMINE LEVEL

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Background / Objective: Nitrogen at pressure has been demonstrated to underlie its narcotic potency by potentiating the function of $GABA_A$ receptors, in contrast to the gaseous anesthetics nitrous oxide that preferentially inhibit NMDA receptors. Indeed, the main target of general volatile anesthetics is demonstrated to be ligand-gated channels inducing neurotransmission alterations. In particularly, such events modify the nigrostriatal dopaminergic pathway activity inducing a decreased DA release in the striatum, structure involved in the motor processes ordering sedative action. Following repetitive exposures to nitrogen, a reversal effect of nitrogen exposure on DA level is obtained suggesting functional receptor disturbances. The aim of this study was to investigate at the level of substantia nigra pars compacta (SNc) the changes in the control of the dopaminergic pathway through glutamatergic and GABAergic inputs.

Materials and Methods: Under general anesthesia, male Sprague-Dawley rats were implanted in the striatum with multifiber carbon dopamine-sensitive electrodes and guide cannulae in SNc for drug injections. After recovery from surgery, the striatal dopamine level was quantified using differential pulse voltammetric (VID) measurements in freely-mooving rats. Effects of specific agonists (NMDA/muscimol) and competitive antagonists (APH/gabazine) of NMDA/$GABA_A$ receptors administration in SNc were studied under nitrogen narcosis at 3 MPa, before and after repetitive exposures at 1MPa.

Results / Discussion: Following repetitive exposures, NMDA, APH and gabazine became inefficient to modify the nitrogen-induced increase of striatal dopamine level. Inversely, muscimol strongly enhanced the increasing effect of nitrogen with a higher magnitude of responsiveness as compared to its initial effect under a single exposure to nitrogen.

Conclusions: Repetitive exposures modify the action of nitrogen at pressure by inducing, in SNc, a lost of inhibitory and excitatory control on DA cells via a blockage of NMDA receptors and a desensitization of $GABA_A$ receptors located on DA cells.

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O 3 WHERE DO BUBBLES FORM?

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Introduction: There is agreement that formation of bubbles is the pathophysiologic basis for decompression injury and clinical symptoms. However, there is no agreement where bubbles mainly form. Following decompression, formation of vascular bubbles in the femoral vein (FV), the liver and the pulmonary artery (PA) was compared.

Methods: Pigs (n=3) were dived breathing air in a dry hyperbaric chamber to 400 kPa with 70 min bottom time. The pigs decompressed at a rate of 90 kPa/min, with two decompression stops at 160 kPa for 22 min and 130 kPa for 46 min respectively. After surfacing, the pigs were monitored for vascular bubbles with two ultrasonic scanners (CFM 750, Vingmed Sound, Norway and Vivid 7, GE Healthcare, Norway).

Observations: Vascular gas bubbles were detected in the

PA and in veins in the liver, but almost no bubbles were observed in the FV. The bubbles in the liver were both attached to the vessel wall and free flowing in the blood. The degree of vascular adhesion seemed dependent upon blood flow. Adherence to the venous or capillary vessels can occur and may prolong appearance of bubbles (Martin and Colley, 1983). The liver as well as the lungs have been suggested as a target organ for decompression (Butler and Morris 1995). Bubbles in the PA may have different origins dependent upon activity during the dive. At rest the liver receives 25% of the cardiac output (CO), immersion will probably increase this percentage. In exercise, total blood flow increases significantly and the majority of the blood is diverted to muscles. Consequently the liver receives less of the CO. As adipose tissues of the lower trunk represent some 40% of all body fat and nitrogen solubility of fat is about five times that of blood, large amount of nitrogen will be stored in the lower body at rest. We hypothize that the inert gas load at rest will mainly originate from the lower trunk, causing supersaturation stress.

O 4 DESIGN OF AN UNDERWATER TELEMETRIC SYSTEM FOR REBREATHERS

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Background / Objective: Acoustic telemetry is an effective method for underwater physiological monitoring. Despite the abundance of telemetric applications for ecology, behavior and physiology of marine life, few efforts were reported about the use of acoustic telemetry for SCUBA divers. We designed a telemetric system to monitor CO_2, O_2 and temperature in the breathing loop of a Draeger Dolphin rebreather.

Materials and Methods: The system consists of an underwater instrumentation unit designed around a microcontroller (*Microchip, PIC18F452*) and PC based surface unit. One oxygen sensor (*Teledyne, R-22D*) is placed in the inhalation side of the loop. One oxygen sensor and one CO_2 sensor are located inside the inhalation side of the canister. Six temperature sensors are located inside the Divesorb containing part. One pressure sensor and one temperature sensor are located outside to monitor the respective ambient values. One pair of acoustic modem (*DesertStar*) establishes the data link between the microcontroller and the topside PC. The graphical user interface of the data acquisition software is written in C#.

Results / Discussion: The actual design of the acoustic telemetry system is rated up to 6 m and is planned to be used only with the pool jet (100% injection) of the rebreather. The temperature of the canister provides a feedback about the effectivity of the CO_2 absorbant. The CO_2 and O_2 measurements are normalized using the ambient pressure recording.

Conclusions: The system should be calibrated using different mixtures of O_2 and CO_2 at different flow rates using unmanned submersions. The telemetry data can be used not only for recording physiological data but also provides an important operational safety tool to monitor the rebreather user. The future designs should include actuators for controlling the diluent and O_2 flow in mix gas diving units.

O 5 SAFETY AND DESIGN OF HYBARIC DEEP DIVE SEMINARS

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Background / Objective: In principal we are convinced that hyperbaric seminars with a deep dive to 600 kPa (50MSW) for recreational divers can be done safely. Furthermore it can be a good demonstration of the acting physical laws on a diver. It is important to position a lecture in diving medicine to the deep dive not only for refreshing the knowledge but also for safety reasons.

Materials and Methods: Data from deep dive seminars in the hyperbaric chamber in Graz were retrospectively analyzed over the last 13 years (n = 68 dives, participates = 1044). The order of events was taken into account in respect of occurrence of negative side effects. The compression rate was limited to 140kPa/min, the maximum ambient pressure was 620kPa (52MSW). The bottom time was limited to 5 minutes. Decompression was done on air without gas switches. Habits (alcohol intoxication and induced dehydration, smoking, insomnia) and compliance of sports divers to pre-seminar instructions and afterwards were undertaken a risk-analysis according to the reported side-effects. The associated rate on DCI was analyzed.

Results / Discussion: During 13 years of practice the proceeding and the prerequisites to be allowed to participate in the seminar needed to be modified to reach nearly no side effects today. At the beginning 4.2% of DCI occurred. By changing and controlling the prerequisites the rate of reported DCI was reduced by 2.6%. The last change in the sequence between lectures and deep dive as well as the introduction of a deep bubble stop succeeded nowadays to nearly none (0.38%) side effects, which are self-reported by the participants.

Conclusions: To be able to conduct secure and instructive deep dive seminars it is necessary to create clear pre-dive guidelines, a strict protocol and have an extended observation period after the deep dive.

O 6 NATURAL FREQUENCY OF THE IMMERSED HUMAN LUNG

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Background / Objective: While many studies have described the changes in respiratory mechanics that occur with immersion, there is a surprising lack of published data on one the more fundamental properties of the human respiratory system, that of the natural frequency of the immersed human lung (Lung_f_0). The aim of this study was to determine the effect of immersion and depth on Lung_f_0.

Materials and Methods: Subjects were 10 male U.S. Navy trained divers. Experiments were conducted while subjects were immersed to the neck seated in a water tank in a hyperbaric chamber at ambient air pressures of 101, 132, 203, 304 and 507 kPa. Additional measurements were taken at surface with the subjects standing unimmersed and while immersed in a prone position. Measurements of f_0 were determined using forced oscillometry in which a custom built loud speaker produced forced oscillations at the mouth using a 5-70 Hz

multi-tone complex with a fundamental frequency of 1 Hz. Respiratory input impedance was calculated from spectral analysis of the pressure and flow measurements taken at the mouth. Lung_f_0 was defined as the first frequency where the imaginary impedance equaled zero.
Results / Discussion: At surface pressure, Lung_f_0 increased from a mean (±SD) of 7.1 (±1.3) Hz unimmersed, to 29.8 (±11.3) Hz when immersed to the neck sitting upright ($p<0.001$). Changing the body position from seated to prone while immersed resulted in a non-significant decrease in Lung_f_0 to 25.4 (±9.6) Hz. Increasing ambient pressure decreased the Lung_f_0 in a similar pattern to the change in gas compressibility with depth ($p<0.0001$).
Conclusions: There is approximately a 3 to 4 fold increase in Lung_f_0 with head out immersion in warm water. The decreases in Lung_f_0 with increasing depth may be associated with the decrease in gas compressibility with depth.
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O 7 4 MONTHS OF INTENSIVE SCUBA DIVING REDUCED BUBBLE FORMATION WITH NO CHANGE IN ENDOTHELIAL FUNCTION

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Background / Objective: The Doppler ultrasonic detection of venous gas embol (VGE) after diving is considered as a useful index for a safety decompression. It was previously shown that a single bout of physical exercise before the dive could reduce the number of VGE after decompression. This could be due to a link between vascular endothelium function and intravascular bubbles formation. This study aimed at determining the effects of combined repeated dives and exercise training on bubble formation and endothelial function of skin circulation.
Materials and Methods: 18 healthy and physically fit Ship Divers from the French Navy (25.3 ± 0.8 year; mean ± sem) admitted to the Mine Clearance Divers course volunteered for the study. The training program lasted 4 months and included 60 sea dives at depths ranging from 15 to 60 m as well as daily exercise training (45 min jogging in the field). Before and after the training program, laser-Doppler was used to measure forearm skin blood flow in the resting state (baseline), during post-occlusive hyperaemia (endothelium-dependent vasodilation) and local heating to 42°C (maximal vasodilation). Subjects were also examined for VGE grade after a single air dive in hyperbaric chamber (30 m depth for 30 min) followed by the standard French Navy decompression schedule. VGE were monitored with a pulsed Doppler on the precordial area 30, 60 and 90 min after surfacing. VGE grades were evaluated according to the Spencer scale and KISS score.
Results / Discussion: None of the divers showed decompresssion sickness. There was no change in weight, body mass index and maximal oxygen uptake during the 4 month course. Bubble grades were significantly decreased after the 4 month training (KISS 16.8 *vs.* 2.0, $p<0.001$, before and after the training program, respectively). This effect was not due to endothelial vascular improvement since no statistical differences were observed for skin blood flow, neither for peak value during reactive hyperaemia nor in response to 42°C local heating.
Conclusions: This study highlights a protective effect of repeated diving on DCS risk. Endurance training and endothelial function seem not implicated in this effect. The mechanisms underlying this adaptation remain to be precised.

O 8 PROTECTIVE EFFECT OF A 2-HOURS PRE-DIVE EXERCISE ON BUBBLE FORMATION: PART OF EXERCISE INTENSITY

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Background: We have previously shown that a single bout of aerobic exercise 2 hours before a simulated dive in a dry hyperbaric chamber can reduce bubble formation. The underlying mechanism is uncertain and biologic or vascular consequences are different in relation to the intensity of exercise. The purpose of this study was 1) to confirm this protective effect in an open-sea field dive 2) to evaluate 2 levels (moderate or strenuous) of exercise intensity on bubble formation.
Methods: 31 healthy divers were included in the study: 19 military divers (37.6 ± 6 years; mean ± sem) and 12 recreational divers (37.0 ± 9 years; mean ± sem). Each subject performed (3 days apart) 3 scuba diving at 30 msw depth for 30 min (MN90 French Navy procedure). The control dive was not preceded by an exercise; two others dives were preceded by a 40 min constant load exercise on ergometer at moderate or high intensity (60% or 85%VO2 max). Circulating bubbles were monitored with a pulsed Doppler on the precordial area 30, 60 and 90 min after surfacing. Bubble grades were evaluated according to the Spencer scale before to be converted in Kissman integrated severity score (KISS score).
Results: None of the divers suffered from decompression sickness. Physical exercises before the dive significantly reduced bubble scores as well with a moderate intensity (KISS $p = 0.004$) as with a high intensity of exercise (KISS $p = 0.001$).
Conclusion: This study confirms data obtained in hyperbaric chamber. A 2-hours pre-dive exercise decreases bubble formation after diving suggesting a protective effect of moderate or strenuous exercise against decompression sickness. This protective effect of exercise might be mediated by several mechanisms and not only Nitric Oxyde (NO) production.

O 9 DOES THE V.O2max VALUE PREDICT THE FORMATION OF INTRAVASCULAR CIRCULATING BUBBLES DURING DECOMPRESSION OF HEALTHY DIVERS?

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Objective: To study a possible correlation between the individual V.O2max value and the quantity of intravascular bubbles formed at the end of a dive.
Methods: 42 male divers took part in this study. At least one week prior to the experimental dive, each subject

underwent an incremental maximum test to determine maximal oxygen uptake (V.O2max) on a cycloergometer. The divers had been told to avoid any physical exercise 48 hours prior to the dive. The subjects were divided into two sub-groups. Sixteen of them completed a dive in a dry hyperbaric chamber and 26 in the open sea. The two dives had the same profile: 30 min at 400 kPa with a 9 min stop at 130kPa (French military decompression table MN90). The age, Body mass index and the V.O2max values of the two sub-groups were similar: respectively 33.3± 3.7 years; 24.1± 1.5 kg.m-2 and 51.7± 8.1 ml.kg-1.min-1 in the case of the divers in hyperbaric chamber v. 37.8± 7.5 years; 24.5±2.1 kg.m-2 and 48.9± 4.5 ml.kg-1.min-1 for those diving in the sea. Circulating venous bubbles were detected on precordial area using a pulsed Doppler 2 MHz, 30, 60 and 90 min. after surfacing.

Results: Bubble formation in both types of dive was significantly correlated to the age and Body mass index of the divers. However there was no significant relationship between the V.O2max values and bubble formation for the two sub-groups.

Conclusion: While it is still true that V.O2max roughly reflects a subject's level of physical activity, which is known to influence bubble formation, V.O2max does not seem to be a good parameter to predict the formation of intravascular circulating bubbles during the decompression of healthy divers.

O 10 PERSONAL CHARACTERISTICS OF SPORTS DIVERS: A QUASI-EXPERIMENTAL STUDY

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Background: Divers are not the most normal men among normal men: a particular personality is requested (Alvis, 1957). Therefore, some characteristics of modern sports divers were evaluated to better understand the differences.

Methods: After searching the literature for data on characteristics of sports divers, 92 female and 113 male divers participated in a survey. All divers were members of diving associations. Two standard questionnaires were employed: Freiburg Personality Inventory (FPI) and Sensation Seeking Scale V (SSS-V). The diving experience was assessed based on the number of dives: beginner, 1–50 dives; advanced, 51–250 dives; and experts, >250 dives.

Results: FPI: Opposite to our hypothesis, divers are less aggressive compared with mean values of normal controls. According to our hypothesis, divers were less emotional. Both findings apply to males and females. 'Extraversion' was comparable between the normal population and divers. Diving experience had no distinguishing effect. SSS-V: Divers had higher scores than normal controls with respect to Thrill and Adventure Seeking, while the scores were lower for Boredom Susceptibility and Disinhibition. Experience Seeking scores were not different as well as the total SSS-V score. These findings were gender-independent. Again, diving experience did not exert a major role: beginners had lower scores for Experience Seeking.

Summary: Changes in the society apply in particular to the recreational behaviour. Trends seem to be directed towards more individualism and increasing adventure seeking. In parallel with an increasing commercialization, the character of sports diving has entirely changed. New educational systems and a plethora of offers (equipment and adventure) have formed the today's diver pattern which only barely compares with that from the pioneering days.

O 11 LUNG FUNCTION IN A COHORT OF SCUBA DIVERS

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Background / Objective: To present the findings of the 2nd phase of a field study using spirometry for the assessment of lung function in recreational scuba divers. The study's two objectives are: 1. To investigate recreational scuba divers' bronchial hyper-responsiveness following a dive; and 2. Monitor the rate of decline of FEV1 over 3 years. It is anticipated that the project will add to knowledge required by medical practitioners when conducting fitness to dive assessments; increase understanding of sport diving physics and physiology; underpin other research and provide direction for new and innovative research.

Materials and Methods: Data were collected from qualified scuba divers on location. Participants completed a short questionnaire requesting information on relevant health history, scuba diving experience. Data on the dive profile were collected post-dive. Easyone® spirometers were used to ascertain divers' forced expired air volume in 1 second (FEV1) and forced vital capacity (FVC), forced expiratory flows at 25,50 and 75% of the forced vital capacity (FEF25, FEF50, FEF75). Spirometry was conducted pre and post dive.

Results / Discussion: Forty-one scuba divers participated in the 2nd phase of this study. The pilot study conducted in 2006 found incidental findings of mild obstructive airways disease pre-dive, unfitness and obesity that warranted further investigation. In addition it was found that recreational scuba divers are continuing to dive over the age of 45 years and consequently have health needs that require appropriate management to keep them healthy and diving safely. The results of the 2nd phase of the study conducted in April 2007 will be compared to the 2006 findings. In addition, the rate of decline in FEV1 in those divers who have had more than one exposure in the study will be presented.

Conclusions: This lung function in scuba divers study has contributed to new knowledge by being undertaken in the field as opposed to the laboratory setting. Many studies examine bronchospasm and respiratory function in scuba divers but few consider sport scuba divers and the resultant pattern of lung function changes that may occur. This longitudinal study has the potential to overcome the limitation of single pilot study carried out at one point of time without sequence of event and more deeply investigate lung function changes in recreational scuba divers.

O 12 ASSESSING FITNESS TO RETURN TO DIVING AFTER DECOMPRESSION ILLNESS AND FOLLOW-UP EXAMINATIONS

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Background: A decompression illness (DCI) could, if not properly treated, cause chronic injury to the CNS. We therefore treat any sign of DCI as quickly as possible according to Table B6. Because of this we only see the early light symptoms of DCI and therefore tend to be conservative when we advise the diver for how long a period he/she should refrain from diving. Every diver treated with recompression is also offered a follow-up including a follow-up visits and examinations of the heart and nervous system.

Method: We recommend all treated divers a visit to a diving medicine specialist after 1 week, 6 months and 1 year and all with a suspected neurological DCI a MRI of the brain and a TEE examination. In addition, all get written instructions regarding the follow-up and recommendations for daily life:

- Limb pain: Uncomplicated recovery: 1 month. With complications: no diving until after all examinations and follow-up visits.
- Neurological manifestations: Uncomplicated recovery: 3 months. With complications: no diving until after completions of all examinations and follow-up visits.
- Pulmonary baro (or other) trauma: No further diving.

Results: We recorded the severity of symptom and performed a selected array of lab-test of 80 divers treated for DCI between 2001 and 2006. 54 of them could be included in a follow-up program including a TEE examination. 26% of these 54 had a Persistent Foramen Ovale (PFO), but of those with more severe symptoms (motor weakness, vertigo, and/or impaired consciousness) 64% had a PFO. None of those examined with MRI had CNS lesions.

Discussion/Conclusions manner: The divers get proper advice regarding continued fitness to dive and a possible. The written recommendations regulate the follow-up of divers with PFO in a systematic closure of the PFO before they get any DCI-induced CNS lesions.

O 13 EMERGENCY FREE ASCENT (EFA) AS A CAUSE OF PULMONARY BAROTRAUMAS (PBT). A RETROSPECTIVE STUDY OF 10 YEARS OF TREATMENT OF DIVE TRAINING (IN-WATER SKILLS) RELATED INJURIES.

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Background / Objective: Out-of-air emergency ascent training carries a great risk of Pulmonary Barotrauma (PBT) and Arterial Gas Embolism (AGE). Despite international recommendations, certification in Belgium still requires Emergency Free Ascent (EFA). In order to evaluate the methodology of diving instruction in Belgium, the aim of this study was to clarify the relationship between PBT and in-water skills during dive training.

Materials and Methods: We reviewed and analysed all 124 non-fatal cases of diving accidents treated at the Centre for Hyperbaric Oxygen Therapy (Brussels, Belgium) from 01/1995 until 10/2005.

Results / Discussion: 49 suffered their injury during performance of an in-water skills training (38.5%). According to our calculation, a training dive (0.456 to 1.36/10,000) is hundred to four hundreds fold more dangerous and an ascent training dive (1.86 to 5.46/10,000 dives) five hundreds to a thousand five hundreds fold more dangerous than a non training dive (0.0035 to 0.0037/10,000 dives) (2-sided p-value <0.0001). From the PBT group (34), 30 were injured during in-water skills training (88.2 %), with EFA in 16 cases (53.3%). The association between PBT and EFA proved to be very significant (p=0.0019, two-sided p-value). The odds ratio is 11.33 (95% confidence interval of 2.186 to 58.758).

Conclusions: It is clear that PBT is more often associated with the exercise of EFA than with exercise of other skills during training. Maintaining the EFA exercise in its present form seems highly questionable.

O 14 A PILOT SURVEY OF ALCOHOL CONSUMPTION AMONG DIVE PROFESSIONALS IN SHARM-EL-SHEIKH

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This is a quantitative study involving the use of both lifestyle questionnaires and portable breath alcohol detectors conducted in Sharm-el-sheikh Egypt during the month of march 2007 among 107 dive professionals. Analysis of the data will show that alcohol consumption in excess of World Health Organisation (WHO) recommended limits are evident among dive professionals and that further, more extensive studies are required to assess the global implications with a view to global policy decisions from the diving industry.

The area of Sharm-el-Sheikh has, over the years become synonymous with the world of SCUBA diving and now ranks as one of the top ten dive sites in the world providing divers of all abilities with breathtaking views of the underworld environment. The region of South Sinai has over 80 dive centres offering initial training through to diver instructor and technical training attracting many of the industry's finest diver educational professionals. The region of South Sinai was thus seen as an ideal platform from which to initiate a pilot study given the wealth of experience of diver operators in the area and without whose help this survey would not have been possible.

Alcohol is a substance that is abused worldwide and especially in diving where excessive alcohol consumption can exacerbate the dehydration process and baratrauma injuries To date there has been no quantifiable data to support any action to either educate or curb the use of alcohol prior to diving. Thus this seminal piece of work aimed to rectify this anomaly by providing substantive data with the aim of educating divers about the effects of alcohol when diving and, where appropriate offer guidance and support to those for whom alcohol has become problematic in their lives.

O 15 DO BUBBLE GRADES DIFFER AFTER A FIRST AND IDENTICAL REPETITIVE DIVE WITHOUT AEROBIC SPORT DURING THE PRECEDING DAY?

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Background / Objective: It is claimed that a deep stop (half maximal diving depth (MDD)), reduces the amount of detectable bubbles (Yount and Hoffman, 1986) and thus may diminish the DCS risk. To ascertain whether it is the deep stop or a prolonged decompression time that is responsible for this effect, the deep stop should not increase decompression time. We examined under this condition whether a deep-stop dive produces less precordially detectable bubbles.

Materials and Methods: 27 divers performed both dives. BGs (KM units) were measured after knee bends 40 and 100 min after surfacing. For testing (paired t-test) scores were transferred to log number bubbles/area (Nishi et al., 2003, B&E). DCIEM prescribes a 12 min reduction of bottom time for the repetition dive (surface interval 2h30min). Without this reduction, the DCS risk (rDCS) increases, which is equivalent to a theoretical increase of BG of 0.36 KM unit. as calculated from an estimate of rDCS at 20 msw for a bottom time of 40 and 28 min (obtained from diving tables with known risk) and the relation between BG and rDCS (calculated from Nishi et al., 2003, B&E).

Results / Discussion: The 2nd dive gives insignificantly less BGs, but the difference is significant when compared to the expected difference of 0.36 KM unit (P values 0.030 and 0.044 for 40 and 100 min respectively). A plausible reason could be the mentioned high occurrence of nuclei, created in the 36 hours of no-endurance activity preceding the first dive. This will produce more Doppler detectable bubbles after the ascent of the first dive than is normally found. As consequence, the difference with the 2nd dive is reduced.

Conclusions: The effect of no aerobic activity during the day before diving seems to be similar in size as the effect of repetition of this identical dive 2.5 h later.

O 16 Mg^{2+} AND AP-5 BLOCKADE OF NMDA RECEPTOR IN HIPPOCAMPAL RAT BRAIN SLICES IS INHIBITED BY HYPERBARIC PRESSURE.

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Background: Pressure above 1.1 MPa induces in mammals and humans the high pressure neurological syndrome (HPNS). HPNS is characterized by cognitive and motor decrements associated with sleep disorders, EEG changes, tremor, and convulsions. Previous theories proposed that augmented response of the glutamatergic *N*-methyl-D-aspartate receptor (NMDAR) or reduced GABAergic inhibition may be involved. Recently, we have reported that isolated NMDAR synaptic response was augmented at high pressure. We tested whether Mg^{2+}, which is the NMDAR physiological blocker is involved, and if AP-5 (2-amino-5-phosphonovaleric acid), which is NMDAR specific competitive antagonist is affected.

Materials and Methods: Sprague-Dawley male rats were used. Hippocampal coronal brain slices were prepared, constantly superfused with physiological solutions, gas-saturated at normobaric pressure, and compressed up to 10.1 MPa with helium. Mg^{2+} and AP-5 were added to the solutions in various concentrations. Pharmacologically isolated NMDAR field excitatory postsynaptic potentials (fEPSPs) of short trains (25-100Hz) were recorded from the dendritic layer of CA1 pyramidal neurons in response to Schaeffer collaterals stimulation. Dose-response curves and effective concentration of 50% responses (EC50's) were measured for the summated amplitude and decay time of fEPSP trains.

Results: Raising $Mg^{2+}$and AP-5 concentrations monotonically reduced NMDAR fEPSPs under control (0.3 MPa) and hyperbaric conditions (10.1 MPa). However, pressure shifted the curves to the right resulting in significantly larger $Mg^{2+}$and AP-5 EC50s for NMDAR fEPSP summated amplitude and decay time:

	EC50 ± SE (n = 6 -10) ; * = p < 0.05			
	Summated amplitude		Decay time	
	0.3MPa	10.1MPa	0.3MPa	10.1MPa
Mg^{2+} (mM)	1.18 ± 0.23	2.34 ± 0.39 *	0.75 ± 0.12	1.5 ± 0.15 *
AP-5 (microM)	7.25 ± 2.59	16.5 ± 4.65 *	7.15 ± 2.29	15.6 ± 1.16 *

Conclusions: These results demonstrate that pressure significantly decrease the efficacy of NMDAR blockade by $Mg^{2+}$and AP-5. These suggest that the NMDAR at pressure undergoes conformational changes that allow greater Na^{+}; and Ca^{2+} influxes. This mechanism may contribute to the CNS hyperexcitability observed in HPNS and possibly to long term neurotoxicity suspected for deep divers.

O 17 EMERGENCY FREE ASCENT (EFA) AS A CAUSE OF PULMONARY BAROTRAUMAS (PBT). A RETROSPECTIVE STUDY OF 10 YEARS OF TREATMENT OF DIVE TRAINING (IN-WATER SKILLS) RELATED INJURIES.

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Background / Objective: Out-of-air emergency ascent training carries a great risk of Pulmonary Barotrauma (PBT) and Arterial Gas Embolism (AGE). Despite international recommendations, certification in Belgium still requires Emergency Free Ascent (EFA). In order to evaluate the methodology of diving instruction in Belgium, the aim of this study was to clarify the relationship between PBT and in-water skills during dive training.

Materials and Methods: We reviewed and analysed all 124 non-fatal cases of diving accidents treated at the Centre for Hyperbaric Oxygen Therapy (Brussels, Belgium) from 01/1995 until 10/2005.

Results / Discussion: 49 suffered their injury during performance of an in-water skills training (38.5%). According to our calculation, a training dive (0.456 to 1.36/10,000) is hundred to four hundreds fold more dangerous and an ascent training dive (1.86 to 5.46/10,000 dives) five hundreds to a thousand five hundreds fold more dangerous than a non training dive (0.0035 to 0.0037/10,000 dives) (2-sided p-value <0.0001). From the PBT group (34), 30 were injured during in-water skills training (88.2 %), with EFA in 16

cases (53.3%). The association between PBT and EFA proved to be very significant (p=0.0019, two-sided p-value). The odds ratio is 11.33 (95% confidence interval of 2.186 to 58.758).
Conclusions: It is clear that PBT is more often associated with the exercise of EFA than with exercise of other skills during training. Maintaining the EFA exercise in its present form seems highly questionable.

O 18 EMBOLISM OF THE SPINAL CORD AND DECOMPRESSION SICKNESS

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Objective: To examine mechanisms in spinal cord embolism relevant to decompression sickness.
Materials and Methods: Magnetic resonance imaging (MRI) of the nervous system of a 21 year old male who developed vertigo 3 days and paraplegia 6 days after a fall playing football demonstrated both cerebellar and spinal cord lesions. MRI of the spine revealed a collapsed inter-vertebral disk at T8-9 suggesting fibrocartilagenous em-bolism. A literature search was made for cases of fibro-cartilagenous embolism and an analysis made of the me-chanisms suggested to account for nervous system injury.
Results and Discussion: The literature search revealed 34 fatal cases of fibrocartilagenous embolism to the spinal cord in which stains for chondrocytic material has established its origin from the nucleus pulposus of a spinal disk. Fibrocartilagenous embolism is usually associated with defects in the vertebral end plates known as Schmorl's nodes which were present in this case. The presence of cerebral lesions indicates that either the material has entered the systemic arterial circulation by traversing the pulmonary microcirculation or by passing through an atrial septal defect. Fibrocartilagenous embolism is stated to be a common cause of neurological lesions in the veterinary literature with cases described in cats, dogs, pigs, horses, sheep, including lambs and even turkeys. Other material found to embolise the spinal cord includes, bacteria, parasites, malignant cells and fat. All are examples of arterial microembolism in which the material is usually trapped in the pulmonary microcirculation.
Conclusions: The discovery that microembolism affects the cord more commonly than usually recognised sugg-ests that, as Haldane suggested in 1908, decompression sickness of the spinal cord is associated with arterial microbubble embolism from the transfer of bubbles into the systemic circulation, either through the lung or through an atrial septal defect. Micro embolism is associated with perivenous demyelination not ischaemic infarction in the nervous system.

O 19 UNDER-ICE RESEARCH: THE INTERNATIONAL POLAR DIVING WORKSHOP

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Background / Objective: Since the first ice dives four decades ago in wetsuits without buoyancy compensators and double-hose regulators without submersible pressure gauges, novel ice diving techniques have expanded the working envelope based on scientific need. During this International Polar Year (March 2007-2009), an increased level of attention will be focused on the Arctic and Antarctic, and this project constitutes a contribution from the international polar scientific diving community.
Materials and Methods: Polar Diving Workshop procedures (Lang, M.A. and J.R. Stewart, eds., 1992) were re-evaluated through the combined international, interdisciplinary expertise of participating polar diving scientists, manufacturers of dry suits and dive computers, physiologists and decompression experts, and diving safety officers.
Results / Discussion: Polar diving experience has shown that buoyancy control is the primary differentiating skill affecting safety and science. The effect of cold on DCS risk is not fully understood; however, pre- and postdive thermal protection must be carefully managed. Ice diving regulator tests demonstrated that pre-dive care (warmth and dryness) is mandatory to minimize the possibility of regulator free-flow. A second-stage isolation valve used in conjunction with first-stage overpressure relief valve should be further considered. Diving under ice requires additional gas management considerations and a minimum of two independent regulator systems is recommended for diving in overhead environments with proficiency in switch-over procedures. A tethered diver, who is deployed to work independently, must be equipped with full face mask, voice communications to the surface, and redundant air supply. A drysuit must be used with a buoyancy compensator for polar diving in general. Polar divers must be highly experienced in the use of dry suits, thermal insulation strategies, weighting, and with the particular equipment they will use under ice.
Conclusions: With the advent of new technology, greater scientific productivity under ice is achieved while maintaining the scientific diving community's exemplary safety record.
The full text of Lang, M.A. and M.D.J. Sayer (eds.) 2007, Proceedings of the International Polar Diving Workshop, Svalbard, March 15-21, 2007, Smithsonian Institution, Washington, DC, is available online at www.si.edu/dive

O 20 EFFECT OF A SINGLE POOL DIVE ON PULMONARY FUNCTION IN ASTHMATIC AND NON-ASTHMATIC DIVERS

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Background / Objective: The population of asthmatic divers is enlarging and many of them dive without problems, despite of physician's opinions as being not fit to dive. One previous study did not found statistically significant difference in Peak expiratory flow between the asthmatic and control group of divers, after single introductory open water dive to 5 m. / 30 min. Aim of this study is to evaluate the effect of a single, pool dive, on pulmonary function in a group of asthmatic divers as compared to controls, as the data are lacking and many contradictory opinions are present in diving community.
Materials and Methods: Baseline pulmonary function tests (PFT), spirometry and flow-volume loop**,** were performed in a group of 19 asthmatic divers and in a group of 15 controls. The same PFT were repeated 10 minutes after single pool dive, on 5 meters/10 minutes.

Spirometry and flow-volume loop measurements and predicteds were performed according to the 1993 European Respiratory Society recommendations. PFT were measured by portable Jaeger SpiroPro device. Student's paired t test was used in the data analysis.

Results / Discussion: In the group of asthmatic divers there were significant reductions of mean forced expiratory flow rates at 50% and 75% of forced vital capacity expired (FEF_{50}, p=0,002; FEF_{75}, p=0,002) after the dive. Asthmatic divers were free of symptoms after the dive. In the group of non-asthmatic divers, we found significant increase in vital capacity (VCIN, p=0,01), forced vital capacity (FVC, p=0,002) and forced expiratory volume in 1 second (FEV_1, p=0,03), after the dive.

Conclusions: Our results indicate that single pool scuba dive to 5 meters, could impair function of small airways in asthmatic divers. We need more data to evaluate the changes in their pulmonary function and to estimate the risk when asthmatics practise scuba diving.

O 21 THE TECHNICAL ERA; CASE REPORT

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Introduction: Due to the increase in the availability of technical diving courses, there has been a drastic increase the number of practicing technical divers. With the increase in technical diver numbers, there has been a corresponding increase in the number of technical diving accidents. We discuss a case that presented in 2001.

Patient / Material: A 41 year old male, technical diving instructor with 200 logged technical dives planned a 150 msw dive in the Blue Hole area in Dahab, South Sinai, with Trimix as a travel and bottom gas, Nitrox for decompression. As he reached the bottom and started the ascent, at 148 msw, the inflator button on his BCD was malfunctioning, and uncontrolled buoyant ascent could not be prevented. Despite attempts to dump and swim down, the diver was unable to stop before he reached 22 msw, missing his decompression stops. Later during the evening, he experienced pins and needles, which crept from his feet upwards to above the waist. This was followed by inability to move the legs and he started to search for help. After driving 100 kilometers from Dahab to Sharm el Sheikh over the mountainous road, 620 meters above sea level, the patient arrived at our center.

Discussion: Haemodynamically no abnormality detected, chest examination was free, skin was free. Neurologically, flaccid paralysis of both lower limbs, urine and stool retention, sensory hypoaesthesia with patches of anaesthesia from the nipples down, loss of all deep tendon reflexes on the lower limbs and superficial abdominal reflexes. The patient was hospitalized and given drugs; parenteral corticosteroid therapy, antibiotics, catheterization, intravenous rehydration with Lactated Ringers. Recompression treatment initially using a COMEX CX30 treatment table, followed by USNTT6, and 16 HBO sessions.

Results: Successfully restored deep and superficial tendon reflexes, urinary and anal sphincter control, and full sensory perception apart from hypoaesthesia on the distal half of the dorsum of the right foot. Condition reached a plateau, leaving a residual of mild paresis of the right foot flexors.

Conclusion: We are seeing more technical diving accidents. Recompression facilities and hospitals in remote areas or in diving destinations must prepare for the new and more aggressive incidents associated with technical diving. The presence of certain factors is essential for adequate management of such cases; including correct preparation and gas availability. In our opinion, it is also essential that treating physicians have sufficient knowledge and experience of the methods employed in technical diving.

O 22 HYPERBARIC OXYGEN TREATMENT FOR ACUTE ISCHEMIC STROKE - A RANDOMIZED SINGLE-BLINDED CASE-CONTROL STUDY AT START

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Background: In Western countries stroke is one of the most common cause of death. Cerebral ischemia results in reduced supply of oxygen to brain cells. Thereby tissue hypoxia plays a key role in the major pathways of cell death. At present the only approved therapy for acute stroke is systemic thrombolysis within three hours after onset of symptoms. Hyperbaric oxygen treatment (HBOT) is leading to an increased blood concentration of dissolved oxygen. Numerous HBOT studies in animals were performed, also by our group. HBOT leads to smaller infarct size, improved survival and better neurological function in animals. Regarding the time point of starting HBOT after cerebral ischemia, treatment after 4 hours had no effect on infarct size. The available controlled and randomized trials in humans performed HBOT within a time window of 24 hours after onset of symptoms.

Aim of the study: In a randomized single-blinded case-control study we intend to determine the effect of systemic thrombolysis in combination with HBOT, starting within 3 hours after onset of symptoms.

Methods: Randomization of 45 patients with ischemic stroke in the next two years, 15 for one of the following groups: systemic thrombolysis combined with HBOT and as control groups systemic thrombolysis combined with normobaric oxygen treatment (NBOT) or systemic thrombolysis alone. HBOT will be performed in a special chamber next to the Neurological ICU of our Department. Treatment pressure is 2.4 ata for 90 minutes. NBOT will be performed by using an oxygen mask giving 1 ata for 90 minutes. Primary endpoints are 1) infarction size measured by MRI, 2) clinical outcome and 3) incidence of intracerebral hemorrhage.

Status quo: The protocol was checked and favoured by our ethics committee. All the requirements for starting are completed. At the time of abstract submission, we are waiting for the first patient.

O 23 HYPERBARIC OXYGEN THERAPY IN DIFFERENT STROKE MODELS IN RATS

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Background: Currently, the only available therapy for acute ischemic stroke is thrombolysis with rtPA, but this therapy holds the risk of secondary hemorragic transformation of the ischemic infarction and is applicable in only 5-10% of all stroke patients. Therefore there is great need for new –adjuvant– therapies in acute ischemic stroke. We investigated the effects of hyperbaric oxygen therapy (HBOT) in different stroke models in rats.

Methods: Rats subjected to mechanical (permanent, experiment1) middle cerebral artery occlusion (MCAO) received 90 minutes of HBOT (2.5 ata) at different time points (15 to 360 minutes) as a single dose or repetitively. In a second experiment (experiment2) rats were exposed to HBOT (60 minutes, 2.5 ata) 180 min after an embolic middle cerebral artery occlusion (eMCAO). In a third experiment (experiment3) rats were subjected to eMCAO to assess safety and efficacy of HBOT (60 minutes, 2.5 ata) in conjunction with rtPA-treatment. Controls were treated with normobaric room air. At 6h (experiment3), 7d (experiment2) or 30d (experiment1) after the ischemic stroke infarction volume, incidence of intracerebral hemorrhage and migration of micro- and astroglia were determined.

Results: In experiment1, early (within 3 h after MCAO), single-dose HBOT attenuated infarct size, reduced microglial cells and increased astrocytes in the ischemic penumbra. There was no benefit with repetitive HBOT. In experiment2 and experiment3, early, single-dose HBOT mitigated infarct size and reduced the incidence of intracerebral hemorrhages (experiment3 only).

Conclusion: Our data demonstrated a significant benefit in two different experimental stroke models in rats using early HBOT. Further studies are needed to investigate the long term effects of the combination of HBOT and thrombolysis and a comparison with normobaric oxygenation. Additionally we plan a clinical investigation to study the effect of the combination of thrombolysis and HBOT in human stroke.

O 24 THE ROLE OF HYPERBARIC MEDICINE IN THE EMERGENCY MEDICINE SYSTEM IN POLAND

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Background / Objective: The role of hyperbaric medicine in the Emergency Department (ED) is continually evolving. In many cases emergency physician are responsive for recognizing the patients, for who Hyperbaric Oxygen (HBO) may be benefit. There are 4 HBO departments in Poland. 3 of them are strictly connected with Emergency Medical System in Poland, and provided by emergency physicians. The aim of this study was to describe clinical experience of the Hyperbaric Oxygen Unit in Wroclaw Medical University in the field of hyperbaric medicine.

Materials and Methods: Record of patients treated with HBO were collected. Data concerning indications, time from injury (first symptoms of disease) to HBO, patients safety were analyzed.

Results / Discussion: January the 1st, 2004 HBO Unit with one monoplace (Baramed) hyperbaric chamber started its activity within Chair of Emergency Medicine, Wroclaw Medical University (Lower Silesia Trauma Center). Our unit serves, mainly, to treat all emergency conditions with HBO which are approved by European Committee of Hyperbaric Medicine and National Health Service in Poland. Number of patients who can be treated in our unit depend on the financial contract of HBO unit with National Health Service. In the year 2004 66 patient were treated, 78 in 2005 and 128 in 2006. The main indication are: CO intoxication – 90 patients, crush injuries and Gustillo type IIIb and IIIc fractures – 42, sudden deafness 45, aggressive soft tissue infections – 32, compromised skin grafts – 25 patients, radiation injuries – 10, chronic wounds – 11, osteomyelitis – 9, and others. There were 112 children (<18 years) in this group. Oxygen seizures were observed in 1 case, barotraumas of the middle ear (Grade I, and II) – 34 cases. Concerning CO intoxication we observed definitely shorter time from intoxication to HBO (mean time 8 hours in 2004, 3 hours in 2006), and in crush injuries (2-3 days after injury – first sign of complication, ie infection, to 1st day of injury in 2006). Increased number of patients is a result of better knowledge of HBO by doctors, Wroclaw trauma standards (every severe, crush injury is now treated in our trauma centre), and HBO advantages in the treatment of complicated, emergency conditions. Scientific popular-ization of HBO during emergency medicine, toxicology, and trauma surgeons congresses in Poland also results in increased number of HBO patients. Our clinical and scientific activity caused that 3 medical academic centers will open HBO monoplace units this year.

Conclusions: Knowledge, understanding of HBO therapy results in increasing number of HBO units in Poland. Strictly connection between ED and HBO results in decreasing the time from injury to HBO. Intensive care requirements for the treatment of intensive care units' patients in HBO chamber and cooperation between critical care providers and emergency physicians (Poland), will also result in the building of new multiplace chamber in Poland (Wroclaw, Bydgoszcz).

O 25 USEFULNESS OF HYPERBARIC OXYGENATION AS SUPPORTIVE THERAPY OF HAEMORRHAGIC CYSTITIS

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Background / Objective: Haemorrhagic cystitis (HC) is a common complication of bone marrow transplantation (BMT). Patients with HC develop gross hematuria, severe pain, occasionally urinary tract obstruction, which can result in hydronephrosis and renal failure. Occasionally HC can be chronic and associated with blood loss. HC contributes to mortality 2-5% in BMT recipients. Numerous therapeutic approached have been tried in HC (hyperhydratation, forced diuresis, bladder irrigation, alum irrigation, antiviral therapy, and sometimes cystectomy. Hyperbaric Oxygen Therapy (HBO) was reported in the treatment of HC when previous treatment failed in some case reports and 1 retrospective study. We report 4 HC patients successfully treated with HBO.

Results / Discussion: Since January 2005 till December 2006 we treated 4 children with haemorrhagic cystitis after BMT. Patients were conditioned with busulfan, cyclophosphamide, and ATG in one case.. First

symptoms of HC (suprapubic pain, macrohematuria, clota) occurred on days: +32, +112, +43, +19. Patients were treated with conservatively: hyperhydration, forced diuresis, antibacterial agents, cidofovir and vidarabine, two-way urethral catheter for bladder irrigation and intravesical treatment with Prostaglandin F2 alpha was inserted. Despite aggressive conservative treatment macrohematuria continued in every case, prostaglandin's treatment wasn't tolerated well and patients required more that 10 red blood cells transfusions. In one case hydronephrosis occurred. The patients were then refered to HBO unit, and a course of 30 treatments in monoplace chamber (2,5ATA) was planned. In 3 cases macrohematuria resolved within 10 treatments, and microhematuria within 22, 26, 32 treatments. In 1 case treatment was stopped because of severe fungal infection and leukemia recurrence.

Conclusions: HBO therapy was painless and well tolerated by every children. Blood red cells transfusion can be stopped in the 1st or 2nd after the HBO is started. HBO is safe and effective for treatment of HC after BMT, when conventional treatment methods fail or in refractory cases.

O 26 COST B14 STUDY ON HBO AND SUDDEN DEAFNESS – UPDATE AND REVIEW OF THE INCLUSION CRITERIA

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Background / Objective: One of the goals of the COST B14 Action "Hyperbaric Oxygen Therapy" (1999-2005) was to improve scientific knowledge and "proof" of the application of HBO in several diseases, by initiating prospective clinical studies. The "HBO in Sudden Sensorineural Deafness" study was aimed at determining whether HBO is beneficial in sudden deafness patients who have not reacted to conventional, high-dose corticosteroid or other medical treatment. A randomized prospective study was designed and approved by local Ethics Committees. This progress report focuses on the enrollment and randomization process.

Materials and Methods: The COST B14 Sudden Deafness Study aims at producing a randomized, prospective study on the efficacy of HBO treatment after failure of "classical" medical treatment in patients with sudden sensorineural deafness of one ear. Patients with sudden (i.e. evolving over less than three days) hearing loss of at least 35 dB (mean loss over 7 frequencies) in one ear are enrolled, after a medical treatment comprising at least high-dose corticosteroids for one week failed to yield significant improvement (mean hearing gain of more than 10dB). Enrolled patients, after informed consent, are randomized into two possible treatment groups. Group 1 receives a 10-day course of standard HBO treatments (minimum 70 minutes of 100% O2 at 2.5 ATA via "demand valve" system or oxygen hood), Group 2 receives no treatment for 10 days. After this study period of 10 days, HBO can still be started in Group 2 patients. In order to not compromise their chances of recovery, randomization must take place before 4 weeks after the onset of the sudden deafness. Evaluations of audiometry and tinnitus are performed on days 1, 6 and 11 of the study period. Side-effects of HBO are recorded. Every patient with Sudden Deafness who presented at one of the participating hyperbaric centers was screened for possible inclusion in the study. When it was not possible to include the patient for randomization, the reason was noted in a screening log. The exclusion criteria were coded and for each excluded patient, up to three reasons for exclusion were noted. For this report, all screening logs were reviewed for four of the 5 participating centers.

Results / Discussion: Patient enrollment started on September 1st 2001; up until now 80 patients have been enrolled. The number of patients screened was 613, which means that only 13.05 % of patients fulfilled the inclusion criteria. Main reasons for exclusion were: insufficient cortisone treatment before screening (20.85%), hearing loss too important (10.73%) or bilateral (9.51%), and unwillingness of the referring ENT specialist to have the patient randomized (7.09%), too long delay between onset of disease and screening (5.06%). Important regional differences exist in the reasons for exclusion, reflecting the "medical culture" of European countries. "Patient refusal" was an exclusion factor in 2.43% of cases.

Conclusions: It appears that (1) Sudden Deafness is a very heterogeneous disease, and often profound or bilateral, (2) optimal co-operation between referring ENT and HBO center is crucial in obtaining "includable" patients, and (3) patient refusal is less a problem than expected. Inclusion of patients for the COST B14 Study is much slower than expected. However, we still believe that for scientific validity, it is necessary to have a subject population as homogenous as possible. On the other hand, as there seems to be no or very little evolution in the knowledge on or the treatment of this disease, we believe it is justified to have the inclusion period stretched out beyond the initially scheduled 5 years. We therefore propose to continue this study and invite other HBO centers to participate.

COST B14 "Sudden Deafness Protocol", available from the Oxynet http://www.oxynet.org/02COSTinfo/Public/SD_Protocol_E_Final.pdf

O 27 DISBARIC OSTEONECROSES IN SPONGE-DIVERS OF KALYMNOS ISLAND

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Background/specific objective: Dysbaric osteonecrosis in sponge-divers of Kalymnos island (a review of 126 cases). Kalymnos island, located in the Eastern Aegean, has the traditional "sponge harvesting" highly prosperous for the last century and a numerous population of retired (age up 85) and active "sponge divers" (ages 18-68) who are the material of our review study.Our aim is to show that shoulder DO is more frequent than coxae DO.

Materials and methods: All proffesional divers have to have an annual health check-up, so they are registered on the Hyperbaric Medicine Dpt of Kalymnos island. Their medical histories and X-rays of the last 4 calendar years have been reviewed. Osteonecrosis is the result of altered compression, creating air or nitrogen bulbs or both which embolise and "destroy" endothelium,enhasing plattelets aggregation creating thrombs, resulting in infracts and

necroses. Other theories also explain the pathogenessis of DO. All divers suffering of DO have had DS I or II and have been treated in our chamber for at least 10 consultations-1,9 atm. for 90 min each time-,resulting in paliative of pains and function of the shoulder lead.
Description of results/discussion: Of the 126 divers (18-85 yrs with 50 yrs of diving at most) only 28 had no signs of DO and they are divers who stopped sponge-diving after 1986 (sponges dissapeared after the Chernobyl accident) but they dive for fishing and oysters. The shoulder - humerus caput- location outnumbers the coxae location of DO (70%-30%) but there is a mixed type in almost half the number of divers. We find no corelation of body-weight-DO. We have excludet ostic dysplacies, eventual tumors or other DD possibilities. They dive to 60-85 meters on compressed air and apply no decompression stops multiple times per day and do not use mixed gasses.
Conclusions: Undisciplined divers usually suffer DS I or II, some have minor strokes they overlook but the onset of DO is mostly invalidating and painfull for the diver. In our review "shoulder" DO outnumbers the "hip"location.

O 28 FROSTBITE AND HBOT: BENEFIT OF DELAYED TREATMENT

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Background / Objective: Frostbite (congeal tic, immersion foot, trench-foot) is localized damage of tissue as a result from longer exposure to lower temperatures. Nowadays that is often the injury in mountain-climbing. Frostbite is characterized with two phase: freezing and re-warming. In second phase path physiology of frostbite is same as that of acute traumatic peripheral ischemia. The cells oxygenation in damage tissue is the most compromised. In those conditions HBOT is indispensable.
Materials and Methods: T In our medical centers 25 patients with frostbite, taken at random, were treated with HBO and classified in the three groups:

1. Frostbite (patients covered in snowstorm), 4 cases,
2. Frostbite (mountaineers), 4 cases,
3. Frostbite (trench-foot), 17 cases.

Same HBOT protocol was used. Patients were breathing 100% O2 under pressure of 222,86 Pa (2.2 ata) during 90 min in mono place hyperbaric chamber, 10 seasons.
Results: In group I the healing was 100% because patients arrived in initial phase of re-warming. In groupie patients came later on 2-3 weeks when ischemic lesions evolved and HBOT delayed, so a demarcation line was let lower. In group III was necessity for repeated HBOT because that is chronicle disease.
Conclusions: HBOT must be added to surgical and medical treatment of frostbite although as delayed.

O 29 ECONOMIC IMPACT ON HOSPITALIZATION OF HBO THERAPY WITHIN A COMMUNITY OUTPATIENT WOUND CARE CENTRE

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Objective: With this study we wanted to assess the clinic and economic impact on hospitalization of HBO therapy within a community outpatient wound care centre.
Materials and Methods: We analysed the activity of the Centre since November 2003, when it became fully operational, up to December 2006, comparing the final data with the initial feasibility plan which indicated also a potential demand evaluation of 1,600 patients with problem wounds in an area with a population of 369,427. Out of 195 patients treated in 2006, we assessed the complexity of the case mix at admission in consideration of wound type (20% of difficult cancer, rheumatic, vasculitic wounds) and seriousness (41% of wounds within C2 – B2 grades of Falanga classification system).
Results: At dismissal, 85% of patients was healed or had improved, only 3% had been hospitalised for amputation. The impact on hospital admission was assessed evaluating the trend of ten DRGs (Diagnosis Related Groups) connected with wound care, with an average weight of 2.11 DRGs points. In 2006 we reported a dramatic reduction in hospital admissions for four DRGs, compared to 2003 and, globally a decrease of 1829 days of hospitalisation with a reduced production per admission of 210.31 DRGs points equal to a saving of 232,975.79 Euros.
Conclusions: Results proved that the use of HBO therapy in a wound care centre can satisfy efficiently the population increased needs for chronic wound treatment. The centre had an impact in significantly cutting back the expenses of hospital admission for pathologies related to chronic wounds. Treatment efficacy was excellent despite wound seriousness at admission.

O 30 SALIVATORY SECRETION RATE BEFORE AND AFTER HYPERBARIC OXYGEN TREATMENT IN IRRADIATED PREVIOUSLY HEAD AND NECK CANCER PATIENTS

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Background / Objective: Radiation treatment for head and neck cancer commonly leads to xerostomia and hyposalivation as well as osteoradionecrosis. Several osteoradionecrosis patients individually reported less xerostomia. Thus, it was the objective to evaluate the effect of hyperbaric oxygen treatment (HBOT) on the salivary secretion rate in patients having recieved radiation treatment for head and neck cancer.
Materials and Methods: 35 patients participated. 18 had hyposalivation at inclusion. 7 were unable to perform the stimulated sialometry because of tooth loss. Each received 30 HBOT sessions (90 minutes, 2.4 ATA) during six weeks. Before the first session and after completion of the last session, unstimulated and stimulated sialometry was performed. Unstimulated sialometry was performed by allowing the patient to passively deliver saliva into a cup for 15 minutes. Stimulated sialometry was performed by chewing on paraffine for 5 minutes while delivering saliva. Saliva was weighed. Patients were asked whether they had xerostomia, and whether HBO changed this sensation.
Results / Discussion: 4/18 hyposalivatio patients had improved to normal unstimulated secretion (>0.1 ml/min.) after HBOT. 5 showed some improvement while 1 experienced a decreased salivation rate. 8 remained unchanged (4 of these having no secretion at all and thus

probably no potential for improvement). The results from the stimulated sialometries did not systematically correlate to the unstimulated. More than half of the patients reported subjective improvement. It is currently unknown why and should be further investigated.
Conclusions: Some patients experienced a quantitative benefit from HBOT. Several patients experienced a subjective improvement from HBOT. Patients experiencing subjective improvement did not necessarily experience quantitative benefit. Further research must focus on saliva molecular content in order to explain why some patients improved qualitatively but not quantitatively. This may also explain why the results from the stimulated sialometries did not correlate to the unstimulated.

O 31 ACUTE CARBON MONOXIDE POISONING DURING PREGNANCY MATERNAL AND FETAL OUTCOME

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Background / Objective: Carbon monoxide is known to be extremely harmful on the fetus, leading to death, fetal malformations and intellectual retardation. Due to ethical reasons, double blinded randomized study to evaluate the potential beneficial role of HBO_2 would be difficult to perform in this specific sub group of CO poisoned pregnant women. A cohort study appears to be a suitable way to study this question.
Materials and Methods: From January 1983 to December 2004, all women, admitted in our emergency department for CO poisoning and who claimed to be pregnant were enrolled in a prospective survey program. All were treated by HBO_2 within 24 hours after CO exposure. Maternal and fetal data were recorded during hospitalisation and follow up after hospital discharge was done by phone interviews of patients, GPs and obstetricians.
Results / Discussion: During the 22 years study period, 568 women claiming to be pregnant were admitted in our emergency department for CO poisoning. 40 % had minor symptoms, 39% neurological signs but had not experienced any loss of consciousness, 19 % had lost consciousness during CO exposure but were conscious on hospital admission, and 2 % remained comatose.
Detailed follow-up was obtained in 509 cases (90%). Maternal outcome was death in 2 patients (0.3 %), long term manifestation in 14 (2.5%), not statistically different from the outcome of non pregnant CO poisoned women. 8 women asked for elective abortion. Thus, evaluation of fetal outcome is possible in 501 cases. Fetal loss occurred in 14 cases (3.25 %), an overall risk not statistically different from the general population, but there 3.17 fold increase in the risk of stillbirth ($p<0.001$ when compared to the general population).476 pregnancies (95 %) ended with the delivery of a normal baby. Malformations were observed in 11 babies (2.5 %), a rate not statistically different from that of the general population.
Conclusions: In this series of CO poisoned pregnant women, treated by HBO_2 within 24 hours from CO exposure, the risk of stillbirth remains increased when compared to that of the general population but the malformation rate is not different. We do not recommend that therapeutic abortion remains systematically proposed to CO poisoned pregnant women.

O 32 HYPERBARIC OXYGEN TREATMENT IN COMBINATION WITH THROMBOLYSIS IN ISCHEMIC STROKE PATIENTS – RESULTS FROM A PROSPECTIVE PILOT STUDY

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Background: Stroke is one of the most common causes of permanent disability in western countries. Currently intravenous thrombolysis is the only approved therapeutic option. Hyperbaric Oxygen Treatment (HBOT) increases dissolved oxygen several fold. Experimental studies showed positive effects of HBOT in acute stroke, e.g. reducetion in infarct volume and better functional outcome.
Aim of the study: This prospective study aimed to investigate the feasibility and safety of combined thrombolytic therapy and HBOT. Furthermore some outcome parameters were assessed.
Methods: In 2000 to 2001 after obtained informed consent 6 patients (age 48 to 79 years) with ischemic stroke were treated with intravenous thrombolytic therapy (0.9 mg per Kg bodyweight) in combination with HBOT starting within three hours after the first symptoms of stroke. HBOT was performed in a monoplace chamber (Oxystar 800, Fa. Haux, Germany) at 2.4 ATA for 90 minutes per session, overall 8 sessions for each patient in 120 hours. Primary endpoint was safety and feasibility of the above mentioned therapy. Secondary endpoints were the change of perfusion deficit in 99mTc-ECD SPECT and neurological outcome at day 90 measured by the NIHSS, Rankin Scale and Barthel index.
Results: There were no complications related to performing HBOT in combination with thrombolysis within three hours after symptom onset. Mean NIHSS reduced significantly from 12.00 (SD 3.16) at baseline to 3.8 (SD 5.6) at three months ($p<0,05$). 5 of 6 patients had a metabolic recovery in the 99mTc-ECD SPECT.
Discussion: This pilot study shows that HBOT in combination with systemic intravenous thrombolytic therapy within three hours after symptom onset in stroke patient is safe and feasible. Randomized clinical trials are necessary to assess the efficacy of the combination HBOT and thrombolysis compared to thrombolytic therapy alone.

O 33 HYPERBARIC ARGON

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Background / Objective: Xenon was found to be organ protective. Recent animal experiment show that xenon decreases infarction size after ischemic attack on brain and heart. The goal of our work is to investigate if hyperbaric argon has similar properties, as a potential treatment modality in the ischemic stroke.
Materials and Methods: An acrylic container connected by a tube with outdoor environment was put in the hyperbaric chamber and it was connected to a blender enabling to achieve different concentrations of oxygen and argon in the container. The proportion of these gases was set by means of ball flowmeters. Ten laboratory rats were put into the container and it was sealed. Compression at the speed of 100 kPa (10 meters of water column)

per 5 min was initiated. From the pressure of 200 kPa pure argon with adjustable fraction of oxygen was inflated to the container to ensure the partial pressure of oxygen in the range of 40 – 60 kPa. Rats were carefully observed. The compression was stopped at maximal accessible pressure 800 kPa. The oxygen concentration was maintained in the range 40 - 60 kPa by changing of oxygen and argon flow. After 30 min of this compression phase the decompression was started with the rate 100 kPa per 10 min. After pressure drop in the chamber to value of 300 kPa decompression was stopped and the container was flushed only with pure oxygen during 40 min.

Results / Discussion: First changes in the rat behaviour came when pressure reached 500 kPa. The animals calmed down and showed minor motor activity. The state changed gradually to deterioration of motor co-ordination when some rats had problems rearing up; they fell over or had problems co-ordinating limbs in motion. The first rat fell asleep (closing eyes and calm breathing was noticed) in 10th minute after the compression was finished. In the decompression stage, rats were gradually waking up and started behaving in a normal way. In further observation of rats all the time according to the protocol (5 days) no divergence from standard was noticed. The rats ingested and showed normal activity. The value of decompression break on this maximum pressure of pure oxygen (40 min) was empirically determined as a period “a little longer” than the period of isocompression and, from the experiment result point of view, seems to be sufficient.

Conclusions: The submitted work can be characterised as a methodology preparation before experiment initiation, studying influence of hyperbaric argon therapy on ischemic brain damage. At present, the team of authors prepares a model of mice cerebral stroke; experiments will start after verifying an adequate model according to a respective record.

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O 34 MANAGEMENT OF PATIENTS WITH NECROTIZING SOFT TISSUE INFECTIONS AT SAHLGRENSKA UNIVERSITY HOSPITAL

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Background: A necrotizing soft tissue infection (NSTI) is a disease characterised by necrosis of the deep soft tissues labelled, for example, necrotizing fasciitis, Fournier gangrene, gas gangrene and 'flesh-eating bug disease'. The management of these infections includes early surgical debridement, antibiotic therapy directed by the identification of the causative organism as well as intensive medical support. Consideration of HBO as an adjunctive therapy is supported by proven biological action together with emerging clinical evidence. We only see about 4 patients with NSTI in our chamber a year of the expected 40-80 in the population of 1.7 Mio in western Sweden.

Method: We plan to change that by launching a management plan for NSTI. We envision the specialist of hyperbaric medicine as the organiser of the following measurements:

1) Specialists of surgery and orthopaedic surgery, infectious diseases, anaesthesiology and hyperbaric medicine evaluate the patient.
2) Management of the patient according to 'Surviving Sepsis Campaign Guidelines for Management of Severe Sepsis and Septic Shock (see www.esicm.org).
3) Immediate administration of antibiotics and immunoglobulins
   a) Suspected G-I origin of the NSTI: Meropenem, 500mg x 3-4
   b) Suspected cutaneous origin of the NSTI: Bensylpenincillin, 3g x 3 & Klindamycin, 600mg x 3.
   c) In addition, if a severe streptococcal infection is suspected: Human Immunoglobulin, 1 gr/kg b/w.
4) Isolation of the causative organism through:
   a) Blood-samples
   b) Samples from devitalised tissues
   c) Lavage of the infected subcutis
5) Expedient surgery followed by daily revisions.
6) Start with HBO, 90 minutes, 2.8 ATA and 43 minute decompression time as soon as possible after initial surgery, followed by an additional 2 treatments the first 24 hours, thereafter 2 treatments/ 24 h.

Discussion/Conclusion: We expect that, by the application of this management plan, patients with NSTI will need less surgery and have a lower mortality rate.

O 35 HYDROGEN SULFIDE POISONING AND HYPERBARIC OXYGENE THERAPY

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Objective: We present a case of poisoning with hydrogen sulphide (H_2S) treated with hyperbaric oxygen.

Background: H_2S is a colourless gas and poisoning usually occurs by inhalation. H_2S forms a complex bond to mitochondrial cytochrome aerobic metabolism in an effect similar to cyanide toxicity. It affects all organs especially the nervous system, toxicity depends on concentration and duration of exposure. High concentrations (>800 ppm) may result in sudden death.

Methods and Results: A young man aged 19 was exposed to H_2S during a routine control of a tank onboard a tank ship. The tank was under pressure. A hatch was opened and resulted in inhalation poisoning causing a serious cough followed by unconsciousness. At the primary hospital the patient was agitated and received large amounts of benzodiazepine before transferral to hyperbaric unit. Here he was intubated due to a Glasgow Coma Score of 7. In total he received 4 treatments with oxygen at 2.8 bars during 90 min. He was extubated on the 2nd day after the trauma. On admission ECG showed significant ST-elevations in all precordial leads. Myocardial enzymes were negative and echocardiography showed no abnormalities. Rhabdomyolysis without kidney affection was seen with a myoglobin peak 2216 microg/l. At discharge 10 days after the trauma the patient was complaining of hearing problems, hoarseness and a soar throat. No neurological problems were noted.

Discussion: Previously, H_2S poisoning has been re-ported resulting in death, myocardial infarction, pulmo-nary oedema and chronic neurological sequelae. Treat-ment suggested has been supportive care, nitrites and hyperbaric oxygen, but evidence is lacking. H_2S causes inhibition of oxidative phosphorylation, which causes a decrease in cellular energy. Hyperbaric oxygen minimises this effect by providing an excess of dissolved oxygen.

Conclusions: A case of H_2S poisoning was treated

successfully with hyperbaric oxygen.

O 36 RADIAL ARTERIAL AND CENTRAL VENOUS PRESSURE PROFILES IN VENTILATED INTENSIVE-CARE PATIENTS DURING HBO THERAPY

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Introduction: Reports about the effect of HBO on arterial blood pressure are controversial and observations of patients in the intensive care setting are rare. This study aimed at investigating the behaviour of invasive arterial and central venous pressures and catecholamine demand in ventilated patients exposed to HBO.

Patients and methods: 13 critically ill patients (9m, 4f, 25-80 yr) undergoing HBO treatments (222.9 kPa, 45-min isopression phase) were enrolled. All subjects received continuous sedation and analgesia, nine had catecholamine support. ICU ventilator setting, PEEP level, and sufficient ventilation (blood gas analysis) were maintained. Augmentation of catecholamine support was considered to be required in case of a decrease of systolic blood pressure below 20% of baseline. Arterial *(ABPsys)* and central venous pressure *(CVP)* , heart rate *(HR)*, peripheral oxygen saturation , transcutaneous oxygen tension and catecholamine dosage were continuously monitored and recorded before HBO therapy *(baseline)*, during compression *(comp)*, isopression (3 phases: *iso 1*: 0-15 min, *iso 2*: 15-30 min, *iso 3*: 30-45 min), and decompression (deco).

Statistics: Double-sided paired t-test. P-values < 0.05 are considered statistically significant.

Results: Mean absolute values ± SD. N=13. *p < 0.05

Parameter	Baseline	Comp	Iso 1	Iso 2	Iso 3	Deco
ABP syst.	130 ± 27	108 ± 34 *	122 ± 29	127 ± 26	126 ± 25	135 ± 23
CVP	11.5 ± 2.7	10.3 ± 3.3	11.5 ± 3.0	11.7 ± 2.2	11.8 ± 2.1	11.6 ± 2.6
HR	82 ± 19	82 ± 17	78 ± 19	79 ± 18	79 ± 17	78 ± 17

Brief augmentation of catecholamine support in one pt..

Conclusion: HBO affected blood pressure only during compression the mechanism of which needs to be elucidated. Average catecholamine dosage remained unchanged.

O 37 THE "NORMOBARIC OXYGEN PARADOX" AN INTERESTING MECHANISM FOR ICU PATIENTS

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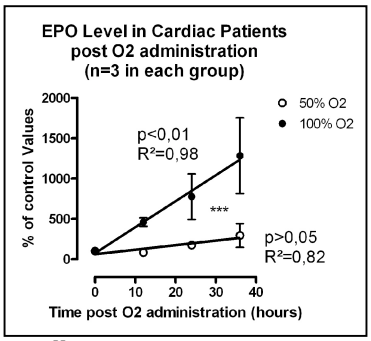
Background / Objective: Erythropoietin (EPO) is a human hormone, synthesised by renal paratubular interstitial cells, that induces red blood cell (RBC) production by activating the red bone marrow progenitor cells. Hypoxia is the main and actually the only recognised trigger for EPO production; it has been well established that reduced oxygen delivery - be it because of anaemia, hypobaric or normobaric hypoxia or reduced renal perfusion – induces a *de novo* synthesis of EPO. Since the understanding of a new trigger of EPO production: the Normobaric Oxygen Paradox (NOP) (Balestra *et al.*, 2006), a clinical application has been set to test the increase of endogenous erythropoietin in post cardiac surgery patients attending ICU.

Materials and Methods: Carefully randomized cardiac surgery patients that gave informed consent according to the ethical committee guidelines (n=6) have been randomly assigned to two different normobaric oxygen concentration groups (50% and 100%). They underwent repetitive blood sampling attending the ICU and at 12, 24, 36 hours after Oxygen breathing. The EPO levels were followed. The patients received 2 hours of 100% oxygen breathing (1 atmosphere) or 50% on top of the medically needed oxygen therapy applied during the surgery. The haemoglobin level of all patients was kept within normal ranges and no hypoxia was allowed.



Results / Discussion: Oxygen breathing for a moderate duration promotes tissular denitrogenation; and increases tissular oxygen levels. After cessation of oxygen breathing, nitrogen partial pressure in all body tissues including the renal tissue, will rise to saturation, causing a concomitant decrease of tissular oxygen tension. This "relative" hypoxia may be able to induce EPO production, without tissue oxygen levels ever dropping below physiologic thresholds. This mechanism seems to be present even after extracorporeal circulation and concomitant oxygenation. The EPO actions on cells are not only considered as important for blood cells progenitors activation but also for neuroprotection and anti apoptotic actions. This has to be considered as a general benefit to the patient with a low cost and no exogenous media injected.

Conclusions: Relative hypoxia is a stimulus for EPO production in humans even in acute conditions; further evidence is still showed by a recent case report in an oncologic patient (Burk, 2007). More clinical studies using the «NORMOBARIC OXYGEN PARADOX» have to be encouraged.

O 38 ENDOTHELIAL CONSTITUTIVE NITRIC OXIDE PRODUCTION PROTECTS AGAINST HYPERBARIC PULMONARY OXYGEN TOXICITY

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Background / Objective: Our previous studies have shown that HBO2-induces acute lung injury, including edema and hemmorage, is eNOS-dependent. Recently, we made

new transgenic mice with altered levels of eNOS activity due to expressing phosphomimetic (S1179D) or an unphosphorylatable (S1179A) form of eNOS. This study addresses endothelial nitric oxide contribution to acute lung injury in HBO2 using these new transgenic mice. The aim of a recent report was to study whether eNOS phosphorylation is involved in HBO2 lung toxicity.
Materials and Methods: Adult wild type C57 BL6/J mice (WT), eNOS deficient (eNOS ko), S1179D and S1179A transgenic mice were exposed to HBO2 at 4 ATA for 2 hours. Total cell count, protein concentration and lactate dehydrogenase (LDH) activity were measured in broncho-alveolar lavage (BAL) fluid as indicators of lung damage.
Results / Discussion: In control groups (mice breathing air), cell counts, LDH and protein content were similar. Protein content and LDH activity increased in all groups of mice exposed to HBO2, as compared to control breathing air. Protein content and LDH activity after HBO2 were higher in eNOS ko and S1179A mice as compared with WT and S1179D mice, indicating more severe lung injury in mice lacking eNOS or having low levels of eNOS activity.
Conclusions: Mice with altered eNOS activity exhibit different lung injury responses to HBO2. The injury pattern suggests that the S1179 phopshorylation site of eNOS is essential for basal NO production that is involved in protection against pulmonary HBO2 toxicity.

O 39 RATING OF THE SATISFACTION FACTOR IN PATIENTS TREATED AT A CLINICAL HYPERBARIC CENTRE: THE QUESTIONNAIRE AT COMPLETION OF TREATMENT

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Background / Objective: At the EUBS 2004 meeting, I introduced the importance of the patients' satisfaction in the setting of a clinical hyperbaric centre, in which the "technical aspects" takes a lot of space. At the EUBS 2006, I proposed a questionnaire of satisfaction.
Materials and Methods: Based on the patients' expectations, as described in my publications the following common dimensions are evaluated: The human relations, the quality of medical and non-medical performances, the accessibility and conveniences, the environmental aspects and the communications. This questionnaire is divided into two sections. In the first section, the questions are positively tinted (e.g. "What is your opinion about the ease of access to the HBO Centre?"). For each question, each possible answer is connected to a quotation. The second section is radically different. To compensate for the "compliant" approach in the first section, it is requested to stimulate the subjective rating: patient's impressions (real life experience) who will indicate clearly what they think. These questions are presented in a negative way (e.g. "There was often a long delay before I could get an appointment with the doctor").
Results / Discussion: As a reminder, the purpose of the rating is to obtain authentic & reliable items which can be interpreted as information as to hyperbaric centre's achievements. Of course, each hyperbaric centre has its own needs and hopes. At this stage, the proposed questionnaire may be used as a "multicentric" study and become an implement which will be used as value reference and will be adapted progressively.
Conclusions: To take into account the patients' satisfaction is an important perceptive parameter for most of us. It is certain that only those implements that show objectivity rate the patients' satisfaction and beyond, have the possibility to develop a healthy and interactive cooperation for the greater benefit of all.

O 40 INITIAL AND CONTINUOUS EDUCATION AND TRAINING FOR HYPERBARIC CENTRE PERSONNEL

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Background / Objective: Until now, initial and continuous education and training of hyperbaric centre personnel has not been defined on a pan European level. As this is one of the main objectives of EBAss (European Association of Baromedical Nurses and Operators), a special Committee devoted on the Education of Personnel has been created, composed of members belonging to each category of hyperbaric personnel.
Materials and Methods: By comparing all existing training and education programs in and outside of Europe, a global and appropriate training system could be prepared.
Results / Discussion: From this comparison, it could be noted that all of the existing training programmes have relatively comparable curricula for nurses, operators and technicians. Only the German directives provide for an attendant training program which is a requirement for progressing further as an attendant and is nurse-only orientated. The American training is the only one that produces a formal qualification of all personnel categories but it has limited use for non-medical staff.
Conclusions: This framework consists of a highly flexible modular system, which is deemed indispensable to obtain a practical solution for training within Europe. In order to obtain each qualification, one has to fulfil its modules, step by step. It is possible to get every qualification in one person (multi role ability) if the basic assumptions are fulfilled. This approach is similar to that of the European Committee for Hyperbaric Medicine (ECHM): flexible and adapted to the realities of the European setting. It aims to integrate the terms of the “European Code of Good Practice for Hyperbaric Oxygen Therapy” prepared by the European Programme COST Action B14 Hyperbaric Oxygen Therapy. In these terms, there is a real need to ensure the same levels of education and qualification for each function, preferably by common education programmes. The present work represents a major step in that direction, but much more work is needed to complete these tasks. It is the responsibility of EBAss to continue this task, in cooperation with the hyperbaric physician’s association(s).

O 41 GENDER IN RELATION TO INCIDENCE AND RISK FACTORS FOR DIVING-RELATED SYMPTOMS OF EAR AND SINUS AMONG DIVEMASTERS AND INSTRUCTORS

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Background / Objective: Information on the incidence of diving related ear and sinus symptoms related to diving activities is sparse. The aim of the present study was to determine the incidence of diving-related ear and sinus symptoms in relation to risk factors.

Materials and Methods: All divemasters and instructors listed with PADI, NAUI and CMAS in Sweden as of January 1st 1999 (2380 divers) were included. The divemasters and instructors received a validated questionnaire on diving activities and diving-related symptoms of hearing loss, ear problems (other than hearing loss), and sinus trouble in 1999 that was regarded as a personal injury that needed medical treatment or caused problems to perform work. 1516 men and 226 women answered, i.e. 73 % of the initial study base. Incidence was calculated per 1000 dives. Multivariate logistic regression was applied in a nested case-control analysis within the cohort.

Results / Discussion: The incidences of ear symptoms were for men and women 4.3 and 11.9 per 1000 dives. For sinus trouble and hearing loss the corresponding male-female incidences were 3.0-6.7 and 1.6-2.3 respectively. In the multiple logistic regression controlling for the different risk factors (per diver) the odds ratio (OR) for having ear problems was for female 2.2 and for young age 2.1. For sinus trouble the OR was 1.7 for both female and young age. Advanced diving was a risk factor for hearing loss (OR=2.0) and sinus trouble (OR=1.8). Endocrine differences may be one causative factor of the gender differences.

Conclusions: We found that female instructors and divemasters reported diving –related ear and sinus symptoms more than males. This relation was consistent even when controlling for potential confounders.

O 42 HUMAN STUDIES ON DIVE RELATED CHANGES IN COCHLEAR FUNCTION

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Background / Objective: During and after decompression from dives, gas bubbles that cause a reduction of the endothelial function are regularly observed in the right ventricular outflow tract. At the time of writing, the role of this phenomenon in tissue injury following diving is still unknown. The normal function of the organ of Corti requires a nor-mal blood flow and microcirculation, thus an endothelial dysfunction can lead to cochlear disorder. Outer hair cells (OHCs) are accessory sensory cells critical for sensitivity of mammalian hearing, because they enhance the sensitivity and selectivity of the cochlea. OHCs are sensitive to most injurious stimuli of the cochlea: hypoxia, ischemia, and drugs. The function of OHCs can be assessed recording the transient otoacoustic emissions (TEOAEs). This study investigates changes in the cochlear function before and after diving, and proposes these changes as markers for endothelial distress.

Materials and Methods: Healthy experienced divers performed a dive breathing air at maximum depth of 30 m for a 20 min bottom time. The ascent rate was 9 m/min with a 3 min safety stop at 5 m. Every subject was evaluated before and after diving with otoscopy, TEOAEs and tonal audiometry. A normal middle ear function was assessed during each session. Divers were retested 2 hours after the dive.

Results / Discussion: Preliminary data shows a statistically significant reduction of TEOAE amplitudes after a no-deco dive. This reduction does not return to basal after 2 hours, suggesting that OHCs requires a longer time to recover. Possible mechanisms are release of endothelial chemical factors or the mechanical obstruction of small vessels by microbubbles.

Conclusions: A no-deco dive causes a reduction in cochlear function measured by TEOAEs. Further studies will be performed to investigate the dose-effect correlation, the duration of the dysfunction, and to determine the relationship between reduction of cochlear function and long term damage.

O 43 EFFICIENCY OF HYPERBARIC OXYGEN THERAPY IN ACUTE ACOUSTIC TRAUMA FROM FIREARMS. A PROSPECTIVE STUDY OF ONE YEAR OF TREATMENT IN MILITARY HOSPITAL "QUEEN ASTRID"

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Background / Objective: Impulse noise from firearms is a common cause of acute acoustic trauma (AAT) which can possibly benefit from hyperbaric oxygen therapy (HBO). Using a retrospective approach, we had decided to monitor our therapeutic protocols for quality control and efficiency assessment. As HBO therapy seemed to improve hearing recovery we decided to prospectively study the therapeutic effect of new protocols of primary hyperbaric oxygenation in association with methylprednisolone and piracetam.

Materials and Methods: 39 soldiers with unilateral AAT were allocated to three treatment groups according to delay of treatment onset. 13 patients (group1) received oral medication only, because of counter-indications for HBO therapy. 19 patients (group 2) with a treatment onset less than 36 hours received HBO twice a day for three days then once a day for seven days. Medical treatment consisted of intravenous methylprednisolone and piracetam for five days followed by oral treatment. For 7 patients (group 3), delay was greater than 36 hours. They received a daily treatment with HBO therapy and oral methylprednisolone and piracetam. Control audiometry was performed after 10 days.

Results / Discussion: Treatment groups are comparable as far as age, gender, initial hearing loss are concerned. The average hearing gain in the group without HBO was 4.61 dB ± 3.05. In the groups with HBO, it is respectively 19.65 dB ± 17 (group 2) and 15.95 dB ± 5.07 (group 3) (P=0,0005, two-tailed). There is no difference between the two HBO groups (P= 0,749, two-tailed). The average residual loss without HBO is -12.18 dB ± 10.26 (group 1). It is respectively -1.93 dB ± 11.96 (group 2) and – 4.28 dB ± 9.37 (group 3) in the HBO groups. Only group 2 is proved significant (P=0,0004, two-tailed).

Conclusions: These results show a clear benefit for HBO and medical therapy over medical treatment alone. We can therefore recommend this approach for patient with AAT. To determine which HBO protocol is the most efficient needs more research.

O 44 ACUTE ACOUSTIC TRAUMA (AAO) ICD-10 H83.3 TREATED FROM 2004 TO JUNE 2007 BY HYPERBARIC OXYGEN THERAPY (HBO) IN WARSAW HYPERBARIC CENTER

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From 2004 to June 2007 in Warsaw Hyperbaric Centre in cooperation with Military Institute of The Health Services, ENT Department were treated 153 patients with sudden idiopathic hearing loss (ICD-10 H91.2) and 45 patients with deafness after AAO (ICD-10 H83.3). Acute acoustic trauma is less definitely common reason of hospitalization but effects of conventional therapy are worse than in sudden idiopathic hearing loss. In the literature, improvement in minimum one frequency up to 20 dB after pharmacological therapy was noted in 34%. Military Institute of The Health Services has more patients with deafness after AAO than civil ENT wards, furthermore number of this injuries greatly increased after beginning of Polish Army participation in Iraq's war.

Objectives: We investigated the effects of pharmacologic and hyperbaric oxygen therapy on patients after acute acoustic trauma. From total number of 45 patients 24 (4 females, 20 males) was qualified for further investigations. Exclusion criteria was resignation from whole cycle therapy and lack of audiometric examination. Pharmacotherapy conducted in Military Institute of The Health Services, ENT Department was standardized (steroids, cocarboxylase, vitamins B group, vasodilators, nootropic agents). HBO therapy was administered according to ULM-2P protocol (90 minutes at pressure 2.5 ata 3 periods of 20 min. of 100% oxygen, with two 5 min airbreaks and 20 minutes for compression and decompression).

Results: Audiometric examinations (250-8000 Hz) proved in 17 (70,83%) cases, improvement up to 10 dB in three frequencies. We noted hearing improvement up to 20 dB in one frequency only in 8 (34%) cases. Except hearing improvement in audiometry, we noted also subjective improvement (reduce of tinnitus, vertigo, full ear).

Conclusions: Pharmacologic and hyperbaric oxygen therapy on patients after acute acoustic trauma improves the results of conventional treatment. The best results were obtained if the treatment was started as soon as possible. Unfortunately during war it's often impossible.

O 45 DIFFERENCE IN BUBBLE FORMATION USING DEEP STOPS IS DEPENDENT ON BOTTOM TIME; EXPERIMENTAL FINDINGS AND THEORETICAL SUPPORT

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Background / Objective: Deep decompression stops compared to more conventional shallower stops have recently been introduced in decompression. Most findings and theoretical work on excess gas phase models suggest an apparent advantage of using deeper stops. However some reports indicate that the incidence and/or risk of decompression sickness (DCS) may actually increase following such procedures *(Blatteau et. al. 2005)*. The motivation behind this paper is to investigate the mechanisms behind these diverging results.

Materials and Methods: The impact of different decompression schedules was tested on pigs compressed in a dry chamber monitored using ultrasonic imaging. A total of 26 pigs were divided into 4 groups of 6 and one group of 2 (aborted protocol). Two groups performed a shallow/long (30 msw / 70 min) dive. One group followed a Bühlmann decompression procedure while the other followed an experimental deep stop procedure (DS1). The three last groups did a deep/short (65 msw / 20 min) dive following a Bühlmann decompression procedure, an experimental deep stop procedure (DS2, n=2) and a revised shallow stop procedure (SS2) respectively

Results / Discussion: The long/shallow dive achieved a significant decrease of vascular bubbles following the experimental procedure with deeper initial stops compared to the controls (Bühlmann schedule) - despite having a shorter total decompression time. So this experiment supports the benefit of deep stops. However, on the deep/short dive the procedure with deeper stops gave a dramatic increase of bubble formation, resulting in the protocol to be aborted after two trials. A new revised experimental procedure schedule with the deepest stops removed, gave a significant decrease of vascular bubble formation. This clearly shows that the effect of deep stops are depending upon the dive performed.

Conclusions: A new stabilizing mechanism for bubble nuclei had to be developed in order to simulate and reproduce the findings in this study. "Traditional bubble models" will in general suggest that adding some deep stops is beneficial for decompression outcome, however this may not always be true. The present studies suggest that deep stops are not recommended on shorter dives and/or dives with very low activity. Deep stops seem to still be beneficial on longer dives, high-activity dives and altitude exposures.

O 46 EFFECT OF A DEEP STOP ON VGE BUBBLES AFTER A 20 MSW DIVE

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Background / Objective: It is claimed that a deep stop (half maximal diving depth (MDD)), reduces the amount of detectable bubbles (Yount and Hoffman 1986) and thus may diminish the DCS risk. To ascertain whether it is the deep stop or a prolonged decompression time that is responsible for this effect, the deep stop should not increase decompression time. We examined under this condition whether a deep-stop dive produces less precordially detectable bubbles.

Materials and Methods: Recreational divers (32) performed either a deep stop profile (DeSt) or a control dive (Contr). Both groups were matched biometrically. MDD was 20 msw, bottom time 40 min and total diving time 47 min. In DeSt, the "deep" stop (10 msw) replaced 4 min of the 7 min stop at 4 msw of Contr. Flex bubbles were recorded 40 and 100 min after surfacing.

Results / Discussion: Statistics (Yates Cochran, and paired t-test) yielded, depending on the combination of the data sets, no, nearly or significance more bubbles

with DeSt than Contr. By calculating %M-values (ZH-L16C), DeSt shows lower values from 10 msw to surface and higher afterward. Strictly, on the basis of Haldanian theory, no benefit can be expected of any deep stop replacing a shallow stop under the prerequisite that M-values are not violated. However, by *adding* the deep stop to Contr, after surfacing the relevant %M-values are lower than for Contr. This effect was found for extension of the ascent with any stop irrespective MDD. The measurements can be understood when less bubble growth due to the lower %M-values during the DeSt ascent is cancelled or overwhelmed by higher bubble growth due to the higher %M-values after surfacing.

Conclusions: As yet, with MDD until about 20 msw there seems to be no reason to abandon the classical practise of surfacing with shallow stops when prescribed.

O 47 HOW SAFE ARE "ACCEPTED" TABLES? SIGNIFICANT INCREASE IN BUBBLE FORMATION IN-WATER

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Background / Objective: The initial testing of new decompression procedures is usually performed in the dry, in some cases this initial testing is performed in animals. Based on such initial testing, the procedures are then tested in humans. Tests are often designed to test the limits of the procedures.

Materials and Methods: Fourteen military divers participated in the human trials. We performed two air dives, one at 24 msw for 70 minutes and one at 54 msw for 20 minutes, first in the dry in a pressure chamber and then in-water in the same individuals. Decompression was performed using the Buhlman tables. After surfacing, bubbles were monitored in the pulmonary artery for two hours. Bubbles were graded using the method of Eftedal and Brubakk (UHM 1998) and transferred to a linear scale (bubbles/cm^2) as previously described (Nishi et al 2003). The risk of DCS was estimated using a modified version of the method described by Eftedal et al (Aviat Space Environ Med 2007)

Results / Discussion: Experimental animal dives, together with the fact that the Buhlman dive tables have been in use for many years, convinced us that this procedure was safe to test in humans. The initial test in the divers in the dry chamber supported this. However, when the same procedure was used in-water in the same divers, the median bubble grade increased from 0-1.5 on the shallow profile and from 0-3 on the deep profiles; the mean bubble grade increased from 0.1 to 2.4 and 1.4 bubbles/cm^2 respectively, an increase of up to 240 %. No symptoms of DCS were observed.

	54 msw/20min		24 msw/70min	
	Dry	In-water	Dry	In-water
Bubble grade (Var)	0.0 (1-3)	3.0 (0-4)	0.0(0-3)	1,5 (0-4)
Bobbles/cm2 (SD)	0.1(0.3)	2.4(2.6)	0.1(0.3)	1.4(2.0)
P(DCS)% (CI)	6(1-20)	28(11-47)	9(3-16)	19(7-33)

The Buhlman algorithm has for many years been considered safe and in fact the duration of decompression is considerably longer (up to 30-60%) then what is recommended both by the US Navy, the Norwegian standard tables and the DCIM (Canadian) tables. Based on the studies of Sawatwki (Sawatzki 1991) and others (Eftedal et al 2007) it is well documented that large number of pulmonary artery bubbles entails a considerable risk of decompression sickness as can be seen in the table.

Conclusions: Vascular bubble formation on in-water dives to the limits of the accepted tables is considerable and may carry a high risk of DCS even with long decompressions. As most published tables have shorter decompression times than what was used in this study, testing is suggested.

O 48 LUNG VOLUME AND DIVING PERFORMANCE IN ELITE APNEISTS

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Background: The ability to perform extended apnea depends mainly on 3 factors: a) the total body gas storage capacity (in blood, tissues and lungs), b) the tolerable levels of hypoxia and hypercapnia, and c) the ability to restrict metabolism (work economy and diving response). To maximize lung volume is an obvious way to increase a), and large lungs with small residual volume are also beneficial for reaching great depths without risking squeeze. Negative effects of large lung volume may be increased surface buoyancy and high intra-thoracic pressure, with a negative effect on venous return, risk of syncope, and a decreased diving response, which is important for c). However, trained divers have previously been reported to have large lungs (Carey et al 1956) and the positive effects may outweigh the disadvantages. The present study evaluated if large lungs are associated with good results in competitive apneic diving.

Methods: Height, weight and vital capacity (VC), without lung packing, were recorded in 14 male apneic divers participating in the apnea world championship in Hurgada 2006. Their previous apnea training experience was 5.8(1.2) years. Individual total competition scores i.e. the accumulated points from dives of maximal depth, time and distance, were compared with lung volumes.

Results: Subject mean(SE) height was 184(2) cm, weight was 82(3) kg and VC was 7.3(0.3) L. Mean dive performance of these subjects was 75(4) m for constant weight deep diving, 5 min 53(39) s for static apnea (resting submersion) and 139(13) m for dynamic apnea (pool distance). A Pearson´s correlation test revealed that lung volume was positively correlated with the total competition score ($r = 0.54$; $P<0.05$). Individual height and weight were not correlated with performance.

Conclusions: We conclude that large lung volume may contribute to successful apnea performance in humans and that any negative effects are outweighed by benefits.

O 49 DIVING RESPONSE AND ARTERIAL OXYGEN SATURATION DURING APNEA IN APNEISTS AND UNTRAINED SUBJECTS OF BOTH GENDERS

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Background: Previous studies suggest that the cardiovascular diving response is more pronounced in divers compared to non divers which may conserve

oxygen and prolong apneas (Schagatay and Andersson 1998). Oxygen conservation is evident when the same duration of apnea results in a higher arterial oxygen saturation (SaO_2; Andersson and Schagatay 1998). To directly compare the magnitude of diving bradycardia and SaO_2 between elite divers and non-divers we used apneas with a fixed duration of 2 min in this study.

Methods: Tests were performed by 27 elite divers; 14 men and 13 women, at the Apnea World Championship 2006. Controls were 16 male and 19 female non divers. Subject sat on a chair for seven minutes while reference heart rate (HR) and SaO_2 were registered (WristOx 3100, Nonin, Plymouth, USA). After countdown and a deep inspiration 2 min apnea was performed.

Results: Among males, 8 of 16, and among females 9 of 19 control subjects performed 2 min apneas. Further analysis is based on subjects performing 2 min apneas. The HR before apneas was similar between all groups (NS). Mean HR(±SE) among male divers during the last 30 s of apneas was 62(4)bpm and among male non divers it was 69(5)bpm ($P<0.05$). Also among females the HR during apnea differed, with lowest values among divers 58(5) compared to 69(4) in the non divers ($P<0.01$). Divers had lower SaO_2 before the apneas among both males ($P<0.05$) and females ($P<0.01$). Male divers reduced their SaO_2 by 4.7(0.9)% and controls by 8.6(1.4)% across the 2 min apnea ($P<0.05$). Female divers reduced their SaO_2 by 7.1(1.0)% and controls by 13.4(1.9)% ($P<0.01$).

Conclusions: The lower HR and higher SaO_2 in divers suggest an oxygen conserving effect of the diving response. Lower SaO_2 in divers before apneas could possibly indicate pulmonary oedema.

O 50 SPLEEN SIZE AND DIVING PERFORMANCE IN ELITE APNEISTS

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Background: Humans share with diving mammals the ability to contract the spleen and increase circulating hematocrit with a possible apnea-prolonging effect (Schagatay et al. 2001). Spleen size is exceptionally large in some deep diving mammalian species like the Wedell seal (Hurford et al. 1996). Spleen size in humans shows great individual variation, but it has not been determined whether human spleen size correlates with apneic diving ability.

Methods: Spleen size was measured in 14 male apneic divers participating in the apnea world championship in Hurgada 2006. Several subjects were individual world record holders. Subjects mean (SE) height was 184(2) cm, weight was 82(3) kg and lung volume was 7.3(0.3) L. Average years of apnea training was 5.8(1.2). Divers rested sitting on a chair for 7 minutes, while spleen maximal length (L), width (W) and height (H) were measured every minute using Ultrasonic imaging. Spleen volume was calculated using the Pilström formula: $L\pi(WT\text{-}T^2)/3$ (Schagatay et.al 2005). The two largest subsequent volumes were used. The apnea competition consisted of accumulating points from dives of maximal depth, time and distance, and the individual total scores were compared to spleen volumes.

Results: Average (SE) dive performance of the subjects was 75(4) m for constant weight deep diving, 5 min 53(39) s for static apnea and 139(13) m for dynamic apnea distance. Mean (SE) spleen volume was 334(33) ml. Pearsons correlation test revealed that spleen volume was positively correlated with total competition points, both as absolute volume ($r = 0.57$; $P<0.05$), and as volume corrected for subject height ($r = 0.55$; $P<0.05$) and weight ($r = 0.57$; $P<0.05$). Spleen volume was not correlated with height or weight. The greatest spleen volumes were found in the three participants obtaining the highest scores, with a mean volume of 538(31) ml.

Conclusions: The study suggests that a large spleen volume may contribute to successful apnea performance in humans.

O 51 DIVING AND HYPERBARIC MEDICINE – A JOURNAL FOR BOTH SPUMS & EUBS?

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The South Pacific Underwater Medicine Society was formed in 1971 by a small group of Australian doctors with Dr Carl Edmonds as the first President. At present, SPUMS has about 850 members. A newsletter commenced the same year, and this evolved quickly into an educational quarterly journal which is now in its 37th year of publication, funded through member's subscriptions. Previously known as the *SPUMS Journal*, its name was changed in 2006 to *Diving and Hyperbaric Medicine* (DHM) to reflect its increasingly international nature. DHM is indexed on EMBASE and can be searched on SPORTDISCUS. Currently indexing under ISI is being sought. The author is the present editor, having taken over from Dr John Knight in 2002.

The European Underwater and Baromedical Society was also formed in 1971 by Dr David Elliott and others at a meeting at the Royal Society of Medicine in London, and a first Scientific Meeting was held in Stockholm in 1973. For many years a newsletter was circulated to members, and then under the co-author's care this evolved in 1999-2000 into the *European Journal of Underwater and Hyperbaric Medicine* (EJUHM). However, EJUHM has always struggled to be a true vehicle for EUBS and to consistently attract articles, and it has had to operate on a very limited budget.

In 2005, EUBS approached SPUMS with a proposal that the two societies consider joining forces to produce a joint journal that could become an international vehicle for diving and hyperbaric research, clinical medicine and education. The SPUMS Executive is sympathetic to this idea and has determined to pursue it with its sister European society. This talk will outline some of the history of the two journals and highlight for members the potential advantages and pitfalls for EUBS of such a joint venture, bearing in mind that DHM is an established, successful journal.

O 52 SPLEEN CONTRACTION AT 2 MIN APNEA AND 20 MIN HYPOXIC BREATHING

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Background: Spleen contraction resulting in ejection of stored red blood cells into circulation occurs during stressful situations in animals and man. The result is an increased gas storage capacity. In humans, both hard

work (Laub et al 1993) and apnea (Hurford et al 1990) have been reported to evoke spleen contraction, and hypoxia to be involved in initiating the response (Richardson et al 2003). Another situation when a spleen response could be elicited is during altitude hypoxia, and the aim of the present study was to compare the response to 2 min of apnea with any responses to 20 min of normobaric hypoxic breathing.

Methods: Subjects were 9 healthy volunteers, 5 women and 4 men, which underwent the following two procedures at different days: 1) Two min of apnea after a deep inspiration of air 2) Twenty min of hypoxic respiration via mask and a gas containing 14.2% oxygen. Both tests started and ended by 10 min of sitting eupneic rest with measurements of spleen size by Ultrasonic imaging (Mindray DP-6600). Arterial oxygen saturation (SaO_2) was registered continuously with a portable pulse oxymeter (WristOx 3100, Nonin). Spleen volumes were calculated by the Pilström equation: $L\pi$ ((WT-T)/3), based on spleen length (L), width (W) and thickness (T).

Results: Pre-exposure mean (SE) spleen volumes were 221(15) ml and 216(16) ml (NS) for the apnea test and the hypoxic breathing test, respectively. After 2 min apnea, spleen volume had been reduced to 145(14) ml ($P<0.001$) and after 20 min hypoxic breathing the volume was 182(17) ml ($P<0.001$, Figure 1). Spleen volume was reduced more by apnea (34±6%) than by hypoxic breathing (16±4%; $P<0.01$). Nadir SaO_2 was 89(1.8)% at apnea and 86(0.9)% at hypoxia (NS).

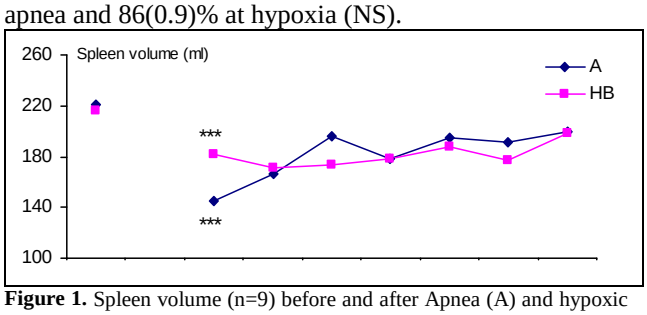

Figure 1. Spleen volume (n=9) before and after Apnea (A) and hypoxic breathing (HB).

Conclusions: We conclude that 20 min hypoxic breathing as well as apnea may induce spleen contraction, but despite similar levels of SaO_2, apnea appears to impose a stronger stimulus.

O 53 SPLEEN CONTRACTION DURING APNEA IN DIVERS AND NON DIVERS OF BOTH GENDERS

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Background: Previous studies suggest that spleen contraction may be stronger in divers compared to non divers (Hurford et al 1990, Richardson et al 2005). In these studies apneic durations were longer in the divers. To compare the spleen response between divers and non-divers at a similar stimulus we instead fixed the apneic duration to a maximum of 2 minutes.

Methods: Tests were performed by 27 elite divers; 13 men and 14 women, at the Apnea World Championship 2006. Controls were 16 male and 19 female non divers. Subject sat on a chair while reference measurements of spleen length, thickness and width were taken every minute for seven minutes using Ultrasonic imaging (Mindray DP-6600), after which a 2 min apnea was performed. After apnea subjects remained seated an additional 7 minutes for spleen measurements. Arterial oxygen saturation (SaO_2) was measured continuously (WristOx 3100, Nonin). Spleen volume was calculated using the Pilström equation: $L\pi$ ((WT-T)/3), based on spleen length (L), width (W) and thickness (T; Schagatay et al 2005).

Results: Mean apneic duration in divers was 2 min, and in control males 1 min 43s, and 1 min 33s among females. The SaO_2 nadir after apnea among males was 93.5% in divers and 90.9% in controls (NS) and among females 91.7% in divers and 90.5% in controls (NS). Spleen volumes before apneas were greater among divers in males (307 vs 267 ml; $P<0.05$), but not in females (166 vs 188 ml; NS). Spleen volumes, corrected for subject height or weight, showed similar results. Spleen contraction tended to be more pronounced in male divers (93 ml) than in controls (64 ml), mainly due to exceptional spleen volumes (532 ml) and contractions (259 ml) in 3 top divers. No differences were observed among females.

Conclusions: We conclude that, at similar apneic durations, spleen contraction is only marginally greater in divers. The limited arterial desaturation during non-maximal apneas in the divers may suggest that their spleen responses were not fully developed.

O 54 THE SINGLE BREATH DIFFUSING CAPACITY BEFORE AND IMMEDIATELY AFTER A BREATH HOLD DIVE TO 30 METERS UNDERSEA

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Background / Objective: It is well known that breath hold divers usually experience hemoptysis during diving. Since the transfer factor of carbon monoxide is the best marker to test the integrity of the blood-gas barrier, it was employed before and after diving in elicited breath hold-divers in order to search for any related changes.

Materials and Methods: The study population consisted of 30 elicited divers (instructors), whose history of breath hold diving was more than 5 years at the time of the study, with personal limit above 50 meters. None of divers were current smokers neither reported cardiopulmonary diseases. All performed standard spirometry, lung volumes and single breath diffusing test according to the ERS-ATS guidelines. The experimental set-up was based on a series of dives progressively increased from 10 to 30 meters and performed during a national course of instructors for learning divers applying for the license to dive. The single breath test maneuvers were repeated immediately after the last diving to 30 meters. Informed consent was regularly signed.

Results / Discussion: Nobody showed signs of airflow limitation neither of hyperinflation at baseline. Single breath diffusing indices were almost normal in all divers. When compared to the baseline values, the transfer factor measured immediately after the immersion showed a significant increase in all divers (more than 30% of the percent predicted). Most of the values returned back to the values recorded before diving in less than one hour. Alveolar volumes did not change.

Conclusions: This study showed that during diving to 30 meters there is a transient increase of the diffusing

capacity. This finding, caused by the increase of intravascular blood volume and the consequent reduction of lung volumes, may suggest the presence of transient alveolar hemorrhage. The continuous insults directed to lung during diving may be responsible of the rupture of the pulmonary capillaries. There is the need to increase the knowledge on the behavior of the lung in this field and to study perspectively the outcome of these results in a cohort of divers.

O 55 THE DIVING RESPONSE: CAN THE REDUCTION IN HEART RATE BE DESCRIBED USING A SIMPLE MATHEMATICAL FUNCTION?

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Background: Reduction in heart rate (HR) is one aspect of the diving response and has been termed diving bradycardia. Depending on the concrete manoeuvre, HR changes highly depend on the individual: HRs down to 10 min^{-1} were observed as well as no changes or even HR increases. In addition, experience and training both affect HR and duration of diving time. It was to be investigated, whether the reduction in HR could be described using a relatively simple mathematical function.

Materials and Methods: Using 'diving reflex', 'diving bradycardia', 'diving response', 'diving plus heart rate', the appropriate data bases were searched. Data from the studies were fitted to different functions. The best fit resulted from the monoexponential function: $HR = c + a \exp(-(t-t_0)/\tau)$, with c an asymptote and τ the time constant of HR decay.

Results: From a total of 850 hits, 200 studies were investigated more closely. Only 8 studies provided reliable data with comparable conditions. HR reduction after apnoea in air had a time constant of 16.2 s^{-1}. Apnoea with face immersion (water ~15°C) intensified the diving bradycardia. Thus, τ was decreased to 10.4 s^{-1}. The mea-sure of determination for the exponential function was high ($r^2 \geq 0.8$) for both manoeuvres. This high correlation was lost, if volunteers were exercising during face immersion.

Discussion: Both during apnoea without and with face immersion, HR decreases along an monoexponential function. The time constant ranges between other reflexes observed in men. Exercise during face immersion could not be described with a simple function, indicating that the parasympathetic reaction is greatly modulated.

P 1 USE OF A RESCUE VENTILATOR AS DEMAND VALVE

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Background / Objective: Especially after severe diving injuries there is always the possibility of deterioration of the patients even during hyperbaric treatment. In most rescue chambers there is no respirator for mechanically ventilation available. The Carevent ALS/BLS® (O-Two Medical Technologies Inc, Canada) is a small, inexpensive rescue ventilator which we tested before in respect of its usability under hyperbaric conditions. Aim of this study was to investigate whether this device can be used with the same comfort as the standard demand valve used in our hyperbaric chamber for spontaneous breathing patients.

Materials and Methods: We used the Carevent® as demand valve in a randomized prospective cross-over trial during routine HBO treatments of patients with problem wounds. 11 patients received oxygen either via the standard demand valve or the Carevent®. They were blinded in respect of the used device. At the end of the treatment as visual analog scale was used to judge the quality of the demand valve.

Fig.1 Carevent

Results / Discussion: A total number of 75 measurements were performed. There was no significant difference was found in the quality of performance between the standard device and the Carevent®. The Carevent® was found to be equal in respect of patients comfort. Therefore it can replace the normally used demand valve during routine treatment.

Conclusions: The Carevent® can be used instead of the standard demand valve with the additional benefit of having a rescue ventilator in place in case of deterioration of patients during HBO therapy

P 2 USE OF A RESCUE VENTILATOR UNDER HYPERBARIC CONDITIONS

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Background / Objective: Very few ventilators are certified for the use in hyperbaric conditions. Specially when treating unconscious patients after diving accidents outside hyperbaric units used to treat intensive care patients there is a need for small, inexpensive and reliable ventilators. We tested the Carevent ALS/BLS® (O-Two Medical Technologies Inc, Canada)[Fig. 1] in respect of his reliability providing constant tidal volumes under hyperbaric conditions.

Materials and Methods: The ventilator was tested on a lung simulator (LS 800, Draeger, Luebeck, Germany) to a pressure of 607950 Pa (6 atm) using pure oxygen to a pressure of 283710 Pa (2.8 atm) and Heliox 50% and Nirox 50% above. The ventilator provides fixed ratios of tidal volumes and frequencies to enable ventilation from childs to adults (from 150 ml / 20 breaths / min to 600ml / 10 breaths / min). Every volume / frequency combination was tested in respect of applied tidalvolume.

Results / Discussion: The tidal volume decreased with increasing pressure. The decrease in tidal volume was more pronounced with pure oxygen and Nitrox 50% than with Heliox 50%. Moreover the main loss of tidalvolume occurred until a pressure of 283710 Pa (2.8 atm) was reached and maintained almost constant above. In the 600 ml setting the tidalvolume decreased down to 340 ml using Heliox 50% at 607950 Pa (6 atm). Although this device can be used in conscious patients as a demand valve, as well as in unconscious intubated patients for volume controlled ventilation its use under hyperbaric conditions is limited due to the distinct decrease of tidal volume under increasing pressure.

Conclusions: Considering a minute volume of 3400 ml/min the maximum weight of a non spontaneous

breathing patient which could be ventilated would be about 60 kg. However, there is the possibility to manually augment the ventilation by an additional pressure support.

P 3 A NEW LOOK AT DIVE COMPUTERS

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Background / Objective: Dive computers, for the vast majority, communicate to the diver simply in terms of numbers and symbols, defined by the lay-out of the display. As long as the computer has to only show depth, time and decompression schedule, this is sufficient. In case of a potentially dangerous situation, using a display with fixed segments the computer can only communicate via blinking elements accompanied by a beeping sound. This can lead to misinterpretation of the risk presented to the diver which can lead to accidents. It is therefore desirable to have a computer with a vast degree of freedom in presenting information to the diver. It is also desirable to have a dive computer designed with particular attention to ergonomics and ease of use. One more aspect to consider is the possibility to "personalize" the dive computer, both to account for the diver physiology during the dive and also to provide information to paramedical personnel in case of an accident.
Materials and Methods: We utilize a grey scale 128x80 dot matrix display, with which any combination of numbers, text and images can be displayed. The user interface utilizes three buttons, the labels of which change with the function of the button itself for increased ease of use. Menus and functions are spelled out in clear text, and the user can choose between several languages. During the dive, warnings and alarms are shown in clear text in the chosen language. Technology by Polar is used for the heart rate measurement. Based on user defined maximum and base values, workload of the diver is estimated from the heart rate and tissue half times are modified when an increased perfusion is detected.
Conclusions: A dive computer as described here presents benefits for divers.

P 4 SEVERE MYOCARDIAL DYSFUNCTION AFTER PROLONGED EXPOSURE TO CARBON MONOXIDE: A POSSIBLE CASE OF TAKOTSUBO CARDIOMYOPATHY

Baert Nele, Vandevelde Karel

Introduction: Takotsubo cardiomyopathy is a syndrome characterized by transient apical left ventricular dysfunction that mimics myocardial infarction in the absence of coronary artery disease and is typically triggered by acute myocardial illness or intense emotional or physical stress. It is mostly seen in postmenopausal women.
Case Presentation: We admitted in our hospital a 63 year old woman after exposure to carbon monoxide during several hours on a camping. Our patient was found unconscious with a Glasgow Coma Scale of 5/15 and she was promptly intubated and ventilated at the place of the event. On arrival at the hospital the carbon monoxide concentration in the blood was 16% after an initial treatment with 100% oxygen during her transfer to the hospital. In the time following admission, after an immediate treatment session with hyperbaric oxygen, she developed severe heart failure with need of high doses of inotropic agents. Pulmonary edema was seen on chest X-ray, cardiac troponine was slightly elevated (0.6 ng/ml) and the electrocardiogram showed diffuse ST-T wave abnormalities. An emergent coronary angiography could not reveal any significant coronary lesions but left ventriculography showed apicoseptal akinesie type Takotsubo with an ejection fraction of 36%. After association of levosimendan, there was a rapid reversal of the cardiogenic shock and follow up echocardiographic examinations showed a progressive restoration of left ventricular function. The patient was extubated after four days and could leave the hospital after eleven days. There was a full neurological recovery.
Conclusion: Prolonged exposure to sublethal levels of carbon monoxide can be a trigger for developing transient left ventricular apical ballooning.

P 5 4 MONTHS OF INTENSIVE DIVING AND EXERCISING: INFLUENCE ON RIGHT-TO-LEFT SHUNTING

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Background: The objective is to investigate if the prevalence and size of right-to-left (R/L) shunting is able to change after 4 months of intensive diving and strenuous exercises in a group of military divers.
Methods: 17 military divers were re-examined for the presence of a R/L shunt 4 months after their initial examinations using a standardized contrast-enhanced transcranial Doppler technique. R/L shunts were classified as type I if observed only after a straining maneuver and type II if present at rest.
Results: The initial prevalence of R/L shunt was 41%: 6 types I and 1 type II R/L shunts. At the second examination, the prevalence was 47% with the appearance of only one R/L shunt (type I) that was not previously present. We found no significant increase in the prevalence and size of R/L shunt.
Conclusion: It is speculated that diving-related phenolmena, such as variations in right atrial pressures during the end stages of or events immediately after a dive could generate a transient R/L shunting. However extreme conditions of intensive diving and strenuous exercises are not able to cause a durable increase in prevalence and size of R/L shunting over a period of 4 months.

P 6 DECOMPRESSION ILLNESS (DCI) AND ROTATOR CUFF DISEASE: REPORT OF A CASE SEEN BY OTHER SPECIALISTS AND CONTROVERSIES REGARDING THE APPROACH

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Case presentation: male, 41 years old, professional diver, was referred from a public General Hospital 24 hours after his last dive, for progressive pain situated over the left anterior chest and shoulder, tingling and weakness of

his left arm. Symptoms appeared 2 hours post ascending and dive profile was at 15 m maximum depth, with 4 hours bottom time and slow ascent over 15 min. Neurological examination revealed deficit of the left extremities. Increase of tendon reflexes and Babinski (+) on the left side was found examining lower extremities, but muscle strength was normal bilaterally. Inability to raise his left arm and increasing pain during voluntary movement was evident. On detailed examination, hand and forearm muscles showed normal strength. Loss of strength was noticed concerning biceps and arm abduction, and raise and adduction of the shoulder appeared normal. Examining his recent history, the day before his last dive he experienced similar symptoms (again after diving) and visited the local health center. He was examined by a General Practritioner, resulting in prescription of anti-inflammatory drugs and referral for neurosurgical evaluation, which he didn't perform, as his symptoms improved. Our estimation was that these clinical features could not be attributed to neurologic DCI only- profound arm weakness with relative sparing of the left leg and strange pattern of arm muscles involvement. The characteristic picture of the patient performing arm abduction made us suspect concurrent rotator cuff tear. An orthopaedic evaluation took place but nothing was further recommended as the orthopaedic surgeon suggested that DCI was prominent. Our strong suspicion and the fact that if existing, this medical condition would affect prognosis, outcome of Hyperbaric Oxygen Treatment, and the indicated plan of treatment, led us to the decision of ordering a Magnetic Resonance Imaging (MRI) investigation. MRI of the left shoulder was performed 7 days after admission, while improvement was evident but recovery incomplete. Partial-thickness rotator cuff tear was diagnosed and appropriate ortho-paedic re-evaluation was performed. Further improvement was achieved and the patient was discharged.

Discussion: In this case, diagnosis of rotator cuff tear was important aiming the complete recovery of the patient. Neurological involvement alone, although mild as we concluded, would suggest a more conservative treatment plan concerning physiotherapy leading to delayed rehabilitation. There is no final conclusion whether pre-existing rotator cuff tear predisposed to DCI (pain) or occurred during diving, giving rise to pain. The patient was diving daily using the above-mentioned profile loading his shoulders with approximately 30 Kgs of ostracea at the end of the dive, and this could be a predisposing factor. However, the joint clinical approach determined the appropriate management. Otherwise, he could have been a patient suffering from DCI with residual symptoms. Moreover, there is a clear plan for his rehabilitation and knowledge of this orthopaedic condition will determine possible limitations and considerations regarding his future diving activities.

P 7 HYPERBARIC OXYGEN THERAPY IN FOURNIER'S GANGRENE AS AN UNUSUAL COMPLICATION OF PREOPERATIVE RADIOTHERAPY; A CASE REPORT

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Background: Fournier's gangrene is a synergistic necrotizing fasciitis of the perineal, genital and perianal region that leads to thrombosis of the small subcutaneous vessels and results in the development of gangrene of the overlying skin. Fournier was unable to identify the cause of infection in his patients, but the etiology can be discerned in most cases today. Anorectal infections, genitourinary infections, and cutaneous injuries are the most frequent sources of infection in necrotizing genital gangrene. Additional host factors such as diabetes mellitus, alcoholism, corticosteroid therapy, malnutrition, renal failure, intravenous drug abuse, cirrhosis, AIDS, leukaemia and radiation therapy affect the development of this devastating disease. The case of Fournier's gangrene presented in this report is very unusual but suggestive, because it developed during radiotherapy and rectal carcinoma was the possible predisposing condition.

Materials and Methods: A 48-year-old male was referred to our center with three days history of perianal pain, discharge and fever. Examination of the perineum revealed a large area of perianal cellulitis with gangrenous skin patches over the scrotum, perineum and perianal region. After the initial debridement, HBO was started and the therapy was administered as two daily sessions of pure oxygen at 2.5 atmosphere absolute pressure for 120 minutes.

Results / discussion: The infection was controlled after the 16th session of HBO and the third debridement. Following the 21th session of HBO the patient was prepared for surgery and abdominoperineal resection was performed. The patient was symptom-free during the control examination that was performed after 3 months. HBO reduces systemic toxicity, prevents extension of the necrosis, narrows the demarcation line and provides a better prognosis when combined with surgery and wide-spectrum antibiotherapy in Fournier's gangrene

Conclusion: This case emphasizes the importance of aggressive surgical and medicatreatment and shows the valuable role of hyperbaric oxygen therapy (HBO) in cases of Fournier's gangrene.

P 8 RISK ESTIMATES OF NITROGEN NARCOSIS DURING DISSUB ESCAPES FROM 600 TO 1000 FT

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Background: In the US Navy, submarine escape is recommended for depths down to 600 ft. However, both escape equipment and escape trunk should function down to 1000 ft. Unfortunately, at these great depths escapers face the risk of nitrogen narcosis. Here we report our attempt to quantify this risk.

Materials and Methods: The risk of N_2 narcosis for different escape profiles from 600 to 1000 ft and different dwell times (DT) in the escape trunk (that is, from completion of pressurization to exit through upper hatch) was calculated using Gas Man® software (Philip JH. Int J Clin Monit Comp 1986). A rate of pressurization corresponding to pressure-doubling every 5s was used. The level of narcosis was expressed as equivalent air depth, (EAD, ft), corresponding to the N_2 pressure present

in vessel-rich-group tissues after 5 min of air diving at that particular depth.

Results: EADs were calculated with different DTs (0s: end of pressurization; 10, 20, 30, 45 and 60s) and lungs-to-brain circulatory delays (CD; no delay, 10 and 20s). Here we report only data for the extremes of our depth range with a CD of 10s. For escapes from 600 ft, EADs ranged from 27 ft with DT of 0s to 491 ft with DT of 60s; for escapes from 1000 ft , EADs ranged from 44 ft with DT of 0s to 818 ft with DT of 60s.

Conclusions: When DT is very short, risk of incapacitating nitrogen narcosis occurring in the trunk is low, even during escapes from 1000 ft. For example, with a DT of 10s at this depth and a CD of 10s, the escaper would probably feel as he were SCUBA diving at a depth of about 230 ft. However, our calculations did not take into account other physiological variables (including O_2 and CO_2) which may affect probability and manifestations of nitrogen narcosis.

P 9 RISK ESTIMATES OF OXYGEN TOXICITY DURING DISSUB ESCAPES FROM 600 TO 1000 FT

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Background: In the US Navy, submarine escape is recommended for depths down to 600 ft. However, both escape equipment and escape trunk should function down to 1000 ft. Unfortunately, at these great depths escapers face the risk of O_2 CNS toxicity. Here we report our attempt to quantify this risk.

Materials and Methods: Risk of convulsions for different escape profiles from 600 to 1000 ft and different dwell times (DT = from completion of pressurization to exit through upper hatch) in the escape trunk was estimated using the equation developed by Arieli et al. (JAP 2002). A rate of pressurization corresponding to pressure-doubling every 5s and ascent rate of 510 ft/min were used.

Results: Here we report only data for the extremes of our depth range. For escapes from 600 ft, probability of convulsions while in the trunk ranged from 0.03 % with DT of 5s to 0.81 % with DT of 60s; for escapes from 1000 ft, it ranged from 0.40 % with DT of 5s to 5.71 % with DT of 60s. As for the overall probability of convulsions (including both DT in trunk and ascent), for escapes from 600 ft, it ranged from 0.20 % with DT of 5s to 1.12 % with DT of 60s; for escapes from 1000 ft, it ranged from 3.10 % with DT of 5s to 8.12 % with DT of 60s.

Conclusions: When DT is very short, risk of O_2 –induced convulsions occurring in the trunk is low, even during escapes from 1000 ft. For example, with a DT of 10 s at this depth, the probability of convulsions is less than 1%. However, our calculations did not take into account other physiological variables (including N_2 and CO_2) which may affect probability of O_2 CNS toxicity.

P 10 NONTRAUMATIC SUBPERIOSTEAL ORBITAL HEMATOMA IN A SCUBA DIVER

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Case report: A 49 year-old man carried out a scuba diving (SD) at 33 meters during 40 minutes; the water temperature was 18°C. During the descent, he felt a brief left temporal pain. At the exit of water, he presented an isolated ptosis of the left eye. Examination of visual acuity and visual field were normal. The CT scan showed a nontraumatic subperiosteal orbital haemorrhage; the MRI excluded a vascular malformation. An anti-inflammatory treatment led to the rapid disappearance of the ptosis; the MRI showed a complete resolution of the hematoma six weeks later.

Discussion: Literature reports 29 cases of nontraumatic subperiosteal orbital haemorrhage among which only two after SD; most are associated with sudden elevation in the central venous pressure (CVP). During scuba diving, there is an increase of the intra-thoracic pressure raised by the cold, by the position of the head and by repeated Valsalva maneuvers. The inhalation of air at 4,3 ATA increases the fraction of inspired oxygen; this hyperoxia involves a bradycardia, a negative inotropism and an elevation of the systemic vascular resistances. These environmental constraints increase the CVP by at least 10 mmHg. The absence of valves in the intraorbital veins facilitates the transmission of this hyperpressure into the orbit where the periost is poorly adherent; the conjunction of this two elements leads to the bleeding by rupture of the subperiosteal veins. The CT scan specifies the location of the hematoma between the lacrymal gland and the right superior muscle; MRI will search a subjacent pathology and will facilitate the follow-up.

Conclusion: The evolution of the disease is often favourable as far as the diagnosis is rapidly performed and helped by the ophthalmologist's opinion in the aim to eliminate a surgical emergency.

P 11 EFFECT OF LATE PURE O_2 BREATHING ON OXIDATIVE DNA DAMAGE IN ANESTHETIZED AND MECHANICALLY VENTILATED SWINE

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Background: Perioperative hyperoxia (FiO_2 0.8-1.0) reduces wound infections and septic complications in patients undergoing elective surgical interventions. While long-term exposure to elevated O_2 concentrations induces DNA strand breaks in healthy rats, we were able to show in a previous study, that it had no effect on septic pigs. Now, we investigated the effect of late O_2 breathing, started 12 h after induction of faecal peritonitis, on DNA damage and repair in a long-term porcine model.

Materials and Methods: After induction of fecal peritonitis, pigs were ventilated with air over 24 or with air over 12 and 100 % O_2 over the next 12 hours. Using the comet assay, we measured DNA strand breaks in whole blood samples and repair of hyperbaric oxygen (HBO)-induced DNA damage in isolated lymphocytes exposed *ex vivo* to 100 % O_2 for 2 hours at 4 bar. Blood isoprostane and nitrate levels were assessed to evaluate lipid peroxidation and NO formation.

Results / Discussion: Sepsis significantly increased the tail moment in whole blood samples, indicating aggravation of DNA damage, and blood isoprostane and

nitrate levels. Late application of O_2 had no further effect on any of these parameters nor on the DNA-damage and repair in HBO-exposed lymphocytes.
Conclusions: During polymicrobial sepsis in swine, which have similar tissue antioxidant activity and susceptibility to oxidative damage as human beings, breathing of pure O_2 is safe with respect to DNA damage and repair as well as oxidative and nitrosative stress, no matter if Oxygen is applied 12 h or immediately after induction of Sepsis.
Supported by the Alexander-von-Humboldt-Stiftung and the Landesgraduiertenförderung Baden-Württemberg.

P 12 THRESHOLD FOR LUNG VIBRATION IN DIVERS EXPOSED TO LOW FREQUENCY UNDERWATER SOUND

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Background / Objective: Increasing use of active low frequency sonar by submarines and ships raises the risk of accidental exposure of recreational divers to low frequency underwater sound. The aim of this study was to determine the threshold for the perception of lung vibration in divers exposed to 10-100 Hz underwater sound.
Materials and Methods: Subjects were 12 male U.S. Navy trained divers. Experiments were conducted in a fresh water pond (Dodge Pond, CT) with the divers suspended in a prone position at 3 m depth. The subjects wore a neoprene wetsuit and breathed surface supplied compressed air. Sound exposures consisted of a series of three sweep tone sets (10–40 Hz, 35–70 Hz, 65–100 Hz) presented at 2 Hz/s at sound pressure levels that were sequentially varied between 105 and 155 dB re 1 μPa in 5 or 10 dB steps. Subjects responded by pressing and holding or releasing an underwater button during the presence or absence of lung vibration, respectively.
Results / Discussion: The mean threshold for lung vibration ranged from 141 to 135 dB re 1 μPa over the frequency range between 33 Hz and 100 Hz. At frequencies below 33 Hz, the threshold for lung vibration droped sharply reaching a minimum of approximately 130 dB at 25 Hz.
Conclusions: Divers breathing compressed air near the surface are most sensitive to lung vibration from low frequency sound exposures at frequencies around 25 Hz. The sharp drop in the lung vibration threshold at 25 Hz corresponds closely with the natural frequency of the immersed lung reported in a companion abstract at this meeting (Fothergill et al., EUBS 2007).
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P 13 FIRST AID OXYGEN IN DIVING ACCIDENTS IN BELGIUM

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Purpose: Oxygen administration is highly recommended as first aid measure in diving related incidents. This study aims to form an idea of the use of first aid oxygen in diving incidents in Belgium and to assess the relationship between first aid oxygen, the number of hyperbaric treatments and the final outcome for the patients.
Material and methods: We reviewed all admitted divers between 01/2000 and 12/2006.
Results: During this period, 283 divers were admitted to our facility. Based on the clinical presentation and actual protocols and guidelines, 223 divers should have received "first aid oxygen" for being highly suspicious for possible decompression illness (DCI) or after an episode of omitted decompression or rapid ascent. 139 divers received first aid oxygen at the waterfront. From the 117 patients being diagnosed with decompression sickness (DCS), only 64 (54%) of them received first aid oxygen. 42 (65%) divers of this group were asymptomatic after the initial hyperbaric treatment, however 22 (35%) received more than one hyperbaric session. 6 (9%) divers had residual injury. In the group of divers (53) who didn't receive first aid oxygen 23 (43 %) were treated once and 30 (57%) received more than one hyperbaric session. 3 (5,6%) divers suffered residual injury.
Conclusion: 1 out of 2 divers (139/283 - 49%) treated in our hyperbaric facility received first aid oxygen at the waterfront. This data suggest that divers with DCS recover faster and need less hyperbaric treatment when they received first aid oxygen. We are aware of the fact that final conclusions can only be established after studies of larger groups and with the availability of reasoning as to why, in some cases oxygen was provided or why not. More attention should be given to the education of the benefits of oxygen first aid delivery within the Belgium Diving Community.

P 14 PREVENTIVE EFFECT OF PRE-DIVE HYDRATION ON BUBBLE FORMATION AFTER OPEN-SEA DIVES

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Background: The influence of fluid balance on DCS risk is not established. To date, no clinical data are available on the influence of pre-dive hydration on venous gas emboli (VGE) formation after decompression. The purpose of this study was to investigate whether prehydration 90 min prior to a dive could decrease post-dive VGE; and to evaluate the consequent adjustments in plasma volume (PV) and blood surface tension (ST).
Methods: There were 8 healthy military divers (36 +/- 6 yr, 24,6 +/- 1,4 kg/m^2) who participated in a crossover trial of pre-dive hydration using saline-glucose beverage (SGB) and a control dive (Con) with no prehydration. Drink volume was 1300 ml of SBG (Osmolality = 324 $mOsml^{-1}$) and drinking time was 50-60 min. The diving protocol consisted of an open-sea field air dive at 30 msw depth for 30 min followed by a 9 min stop at 3 msw (sea temperature = 16°C). Blood samples were taken for hematocrit, hemoglobin and plasma surface tension before/after fluid intake and after the dive; body weight was recorded at the beginning and at the end of the experimental study and urine volume was collected. Decompression bubbles were examined by a precordial pulsed Doppler every 30 min for 90 min after surfacing.
Results: VGE activity was lower for SGB protocol than for Con ($p = 0,031$). PV increased significantly after fluid ingestion by 3,5 % ($p = 0,016$), whereas it decreased by 2,2 % after diving for Con ($p = 0,014$). Differences in post-dive PV between the 2 conditions were highly

significant (p = 0,007). Body weight loss and urine output after diving were significant in both protocols (p < 0, 05) but the decline in weight remained lower for SGB than for Con (mean – 390g vs – 975g, p = 0,016) with a trend towards a higher urinary loss for SGB (-1440 ml vs – 859 ml, p < 0,1). There were no significant differences in ST before and after fluid intake and between the 2 conditions.
Conclusion: Our study supports the idea that pre-dive oral hydration of 1300 ml of an hyperosmotic fluid decreases circulatory VGE, thus offering a relatively easy mean of reducing DCS risk. The prehydration condition allowed to attenuate dehydration and hypovolemia induced by the diving session. Conversely, hydration did not appear to increase plasma surface tension in this study, and consequently may have less influence on the risk of DCS than was previously thought.

P 15 OXIDATIVE STRESS IN GERMAN COMBAT SWIMMERS AND UDT DIVERS: EVIDENCE FOR ADAPTION

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Background / Objective: Exposure to hyperbaric oxygen (HBO) causes oxidative DNA damage, but is rapidly repaired and an adaptive protection against further HBO-stress is triggered. Combat-Swimmers and UDT-divers are frequently breathing oxygen at high pressures similar to repeated HBO exposures. Therefore, these divers may present similar oxidative changes and/or adaptive responses as reported with HBO-exposure.
Materials and Methods: 52 volunteers were distributed into 4 groups (Combat Swimmers, UDT-divers, Naval pentathlon athletes, Control Group). Superoxide dismutase (SOD) and catalase (CAT) activities were determined in plasma and blood. The comet assay was used to evaluate DNA strand breaks in blood and isolated lymphocytes. Electron spin resonance (ESR) trapping was used to examine basal $O_2^{\cdot-}$ levels of isolated lymphocytes before and after HBO exposure.
Results / Discussion: Neither plasma and blood CAT and SOD activities, nor the comet assay reflected any difference between groups. Initial comet assay results of the isolated lymphocytes also reflected no differences. Exposing lymphocytes to HBO produced DNA strand breaks in all study groups but with a significantly higher tailmoment in Combat Swimmers. All tailmoments returned to basal after a 1 h repair period. HBO exposure of isolated lymphocytes caused significant increases of $O_2^{\cdot-}$ levels in all groups with significantly higher levels in Combat Swimmers and UDT-divers than in the other groups.
Conclusions: Repeated exposure to hyperbaric oxygen in combat swimmers and UDT divers do not result in detectable adaptative processes. Furthermore, exposure to HBO in isolated lymphocytes from all subjects lead to a increase in tailmoments. Interestingly the increase in tailmoments after HBO exposure was significantly higher in combat swimmers than in all other groups but returned to normal 1 hour after exposure. The explanation remains speculative, but this may be the result of a very early and rapid reparation process in these subjects.

P 16 DIVING – AN OPTIONAL THERAPY AGAINST SPASTICITY IN PARAPLEGICS

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Background: Spasticity is often a handicap in paraplegics and interferes with quality of life. Medical therapeutic options lead to drowsiness, fatigue and loss in activity. On the other hand paraplegics are increasingly active in daily life and leisure (paralympics). Neurorehabilitation is effective in reduction of spasticity, gaining motor function and enhancing quality of life. Already 15 years ago Madorsky et al pointed out SCUBA diving as a positive neurorehabilitation procedure. These references inspired to introduce a prospective study.
Patients and methods: After obtaining an ethic votum and evaluation assesment for diving permission 7 volunteers with paraplegia entered the pilot study. Medication was kept stable throughout the study time. Supervised by diving instructors and a diving trained doctor the volunteers dived to a platform in the depht of 7.2 meters. The daily diving time was exacty 30 minutes. Stabilized on the platform physiotherapeutic assessment took place in different positions to reduce spasticity. Ashworth Scale and spasm frequency scale were noted daily. At beginning and end of the study the WHO Quality of life Test had to be completed. For objective reasons a locomat training happend before, within a week after and 4 weeks after the study week.
Results: All patients did the daily dives without any difficulties. The statistic included the assessment of day 1 versus day 7 of 5 patients and showed a significant reduction of Modified Ashworth Scale ($p<0.04$). The WHO Quality of Life Test of 7 patients was also significantly improved ($p<0,05$) in the Wilcoxon Signed Ranks Test.
Discussion: The improvement rationale can only be supposed. A correlation to the ambient pressure suggests itself. Therefore deeper depths should increase the good spasticity results or manage to achieve those faster. Many questions remain so further studies are necessary to ascertain the ideal standard options.

P 17 A CASE OF BUERGER'S DISEASE TREATED WITH HYPERBARIC OXYGEN

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Introduction: Buerger's disease, a nonatherosclerotic vascular disease also known as thromboangiitis obliterans, is characterized by the absence or minimal presence of atheromas, segmental vascular inflammation, vasoocclusive phenomenon, and involvement of small- and medium-sized arteries and veins of the upper and lower extremities. The obstruction of blood vessels in the hands and feet reduces the availability of blood to the tissues, causes pain and eventually damages the tissue. The condition is strongly associated with heavy tobacco use, and progression of the disease is closely linked to

continued use. The typical presentations are rest pain, unremitting ischemic ulcerations, and gangrene of the digits of hands and feet, and as the disease evolves, the patients may require several surgical amputations.
Case Report: A 53-year-old female patient was referred to our hyperbaric unit in March 2006 with ulcers on the tips of the fingers on both hands. The patient was a heavy smoker with a past medical history of Raynauds disease. At the time of assessment the patient had extremely painful hands with ulcers on the index and middle finger of the right hand and the middle finger of the left hand. The tips of the rest of the fingers were cold and white. The patient had been advised to stop smoking immediately (she only reduced the amount but did not stop completely) and was treated with vasodilator therapy (Iloprost) with only slight improvement. A sympathectomy on the worse affected right side was planned. Before this a course of HBO was initiated to rescue her fingers.
HBO treatment: The patient received a total of 30 HBO treatments. At the end of the treatment the ulcers had healed and the pain had improved. As a result the sympathectomy was not necessary anymore.
Conclusion: HBO therapy may have an important role in the early treatment of Buerger's disease.

P 18 BRAIN PERFUSION CHANGES AFTER HYPERBARIC OXYGEN THERAPHY IN THE CHILDREN WITH AUTISM

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Background: Autism is the most common disesae of the Pervasive Developmental Disorders (PDD). Many cases of autism today are, in fact, cases of gut-brain inflamation secondary to toxic heavy metal poisoning.
Materials and methods: This study shows the brain perfusion changes secondary to brain inflamation and effects of Hyperbaric Oxygen Theraphy (HBOT) in 108 children with autism. We performed a retrospective review in search of DMSA provocated urine toxic metals profiles. MR imaging and common functional abnormalities with brain Single-Photon Emission Computed Tomography (SPECT) of these children. We applied 50 sessions HBOT for each patient at 1.5 ATA for 60 minutes/daily. Then we compared the results of SPECT scans before and after the therapy.
Results/Discussion: Before HBOT**,** all 108 cases have elevated or highly elevated levels of lead and most of them were in company with some other toxic heavy metals such as mercury, arsenic, nickel and tin etc. on their DMSA provocated urine toxic metals profiles. All of the patients had abnormal SPECT scans and were revealed focal areas of decreased perfusion in temporal lobe of the brain were noted in all cases. By contrast all patients had normal MRI findings. After HBOT, all patient's SPECT scan findings has dramatically improvement.
Conclusions: In conclusion, extensive perfusion impairments involving the temporal lobes were found in this study. SPECT scans may be more sensitive in reflecting the pathophysiology of autism than MRI. HBOT were also found an effective treatment method for brain perfusion impairment in autism.

P 19 LEFT VENTRICULAR DIASTOLIC FUNCTION CHANGES DURING BREATH-HOLD DIVING IN HUMANS

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Background / Objective: Diving reflex induces, in marine mammals, a significant decrease of cardiac output due to a combined effect of reduced venous return, reduced myocardial contractility and increased peripheral resistances. Recent studies demonstrated, also in humans, a decrease of cardiac output during breath-hold diving. Aim of this study was to evaluate if diastolic function changes can contribute to the hemodynamic response to diving.
Materials and Methods: Fourteen experienced male divers (age 37±5) underwent a variable weight breath-hold dive at 10m depth. Cardiac anatomical and functional assessment during dive was performed by an underwater echocardiographic machine. Left ventricular volumes, stroke volume and cardiac output were obtained by two-dimensional echocardiographic evaluation. Early (E), late (A) transmitral diastolic velocities and Deceleration Time of E peak (DTE) were measured by pulsed wave Doppler and assumed as indexes of left ventricular diastolic function. Differences between diving and basal conditions were assessed by Student's "t" test for paired data.
Results: Left ventricular stroke volume and cardiac output significantly decreased during dive (82.7±25.2 vs. 69.0±23.6ml, $P<0.05$; 5.8±2.2 vs. 3.7±1.1l/min, $P<0.01$, respectively). As concerns diastolic function indexes, a significant increase of E (70.9±12.8 vs 87.1±8.1cm/sec, $P<0.01$) and a significant shortening of DTE (240.6±43.6 vs. 159.2±30.0m sec, $P<0.001$) were observed.
Discussion: The present study confirms that breath-hold diving induces a reduction of cardiac output, mimicking the diving response observed in natural divers. Left ventricular diastolic function pattern during diving (increase and sharpening of early diastolic filling flow) resembles that observed in restrictive/constrictive cardiac disease. An *"ab extrinseco"* compression on the heart, possibly due to the combined effects of a reduced chest volume and an increased blood content of the lungs, could represent one of the mechanisms at the basis of hemodynamic changes induced by diving.

P 20 BAROTRAUMATIC ORBITAL EMPHYSEMA IN BREATH OLD DIVER

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Introduction: Barotrauma in scuba diving is typically seen in the middle ears, sinuses, lungs and some times in the teeth. To our knowledge no previous report of Barotraumatic Orbital emphysema in breath hold diver has been reported as recorded in peer reviewed literature. This is a case report of such event.
Materials and Methods: A 29 year old male did many breath hold dives to no more than 20-25 mt (60-75 fsw) well without any problem. At the end of the dive day, after some difficulty to equalize the ears, appeared left

proptosys without any other symptoms. No obvious findings in the rhynoscopic examination and no neurological or visual signs are found at the Physical examination.
Results: CT maxillo facial scan found air into the subcutaneous soft tissues of superior palpebral space and adjacent intraparenchymal orbital air as a result of barotrauma. No fractures involving the orbit or dehiscence of the lamina papyracea was found and not intrasinus hematoma were observed. Management was conservative. Symptoms resolved steadily. The diver continued his recovery at home. He has been advised not to scuba or flight. After 3 weeks of follow-up, the patient completely recovered and he takes back the underwater activity without any complication at the forth week.
Conclusion: We present a preliminary case report of apparent rhinosinusal barotraumas with air trapped in orbital space without evidence of any orbital, paranasal sinus, or cranial fracture. The barotraumatic orbital emphysema in divers is generally a benign entity that requires supportive care, and resolution occurs spontaneously. Should there be any suspicion of compression of the orbit, it must be early drained surgically to allow the assessment of visual function and theoretically prevent a potentially irreversible ischemic visual loss.

P 21 COMPARISON OF FINGER SKIN TEMPERATURE CHANGES DURING IMMERSION IN FOUR DIFFERENT WATER TEMPERATURES

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Background / Objective: The purpose of **Study 3** was to evaluate the cold induced vasodilatation (CIVD) response in fingers at four different water temperatures: 5°C, 8°C, 10°C, and 15°C. The rationale for this study was to identify whether lower water temperatures induce stronger CIVD responses in fingers. This study was also conducted to find the temperature of the water that induces strongest CIVD responses in fingers.
Materials and Methods: Nine healthy young male subjects participated in four experiments on four consecutive days. Finger skin temperature changes, blood pressure, heart rate and subjective ratings of thermal comfort and temperature perception scores were compared between these four immersions.
Results / Discussion: The CIVD response was stronger and more frequent during immersion of the hand in 5 and 8°C compared to 10 or 15°C water. No differences in CIVD were found between the 5 and 8°C immersions. However, during immersion in 5°C, subjective ratings of thermal discomfort were greater.
Conclusions: We conclude that a water temperature of 8°C is optimal for CIVD research. CIVD responses (although less frequent) were also observed during immersion of the hand in 15°C water indicating that this protective vasodilatatory mechanisms may occur even at moderately cold conditions, normally associated with the upper thermal limits for risk of non-freezing cold injuries.

P 22 DCS OF ARTERIAL ORIGIN - A POSSIBLE IMPOSSIBILITY IN NO LIMITS BREATH-HOLD DIVING?

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Background / Objective: Most reports of neurological problems after breath-hold diving involves repetitive diving with a few cases of single dives with fast ascent. In 2005, after a "No-Limits" dive to 209m, a diver showed signs of neurological impairment which resolved after HBO treatment. In contrast to the repetitive diving were nitrogen loading can be calculated and correlated to symptoms the mechanism for DCI after a single dive is not clear. In addition to DCS from tissue supersaturation and and AGE from pulmonary barotrauma we hypothesize that supersaturation and bubble formation in arterial blood may be possible due to rapid ascent.
Methods: Data from internet reports and personal communications with divers on a No-Limit dive where the diver were treated with HBO due to neurological signs and symptoms.were evaluated.
Results: Single dive, max. depth 209.6 m, max dive time 3.30 min, ascent speed 140 m/min,20 minutes after the dive the diver showed signs of weakness, were unstable and unable to walk.
Discussion: The rise in pN_2 during a breath-hold dive to 200m will depend on pressure but also the physiology of breath-hold diving: compression of gas will result in an enormous diffusion gradient from alveoli to blood but also in a less effective exchange area in the lung while blood flow will be reduced due to the diving response. Decompression then is explosive with ascent rates around 3 m/s. This may result in arterial bubble formation with small but disseminated bubbles.
Conclusion: Such decompression derived bubbles in cerebral vessels might be an explanation for neurological impairment in extreme apnea divers and probably are the real limitation in "*no limit*" dives.

P 23 EMPIRICAL CLASSIFICATION OF DCS PATIENTS USING CLUSTER ANALYSIS

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Background / Objective: Decompression Sickness (DCS) defined at the diagnostic level encompasses various signs and symptoms according to which its type is determined. However, there is a discrepancy about the classification. Perceived Severity Index (PSI) suggests 6 hierarchical types of DCS, U.S. Navy classify as Type I and Type II, in Russia, DCS is classified into 3 types. The objective of this study is to investigate the utility of multivariate statistical methods on the empirical classification of DCS patients and the sign and symptoms patterns in different patient groups.
Materials and Methods: The sample for this study consisted of 39 cases reported by the sign and symptom checklist of the DAN Europe Diving Injury Report. An agglomerative hierarchical cluster analysis with squared Euclidian distances and Ward's method to establish clusters is used to classify the DCS patients using SPSS

13.0 (SPSS Inc., Illinois). Arbitrary numbers of 2, 3, 4 and 5 are selected for clusters.
Results / Discussion: For every analysis, chi-square values are calculated to reveal any significant difference between the clusters by the variable in question. For the analysis with 2 clusters, 4 variables have significant p values ($p < 0.05$). For 3, 4 and 5 clusters, the number is 6, 11 and 11 respectively. As the result, a classification of 4 clusters of patients is optimum with the current data. However 39 cases are not sufficient for an accurate classification.
Conclusions: This study can be considered as a pilot application of statistical classifying methods on DCS. The main idea is to have opinions about how DCS can be investigated empirically, using multivariate data analysis methods. Larger samples will enable the use of different methods such as Twostep cluster analysis and will yield more meaningful and significant results that may provide to the experts a different conception of DCS beyond Type I and Type II.

P 24 CHANGES IN CARBONYL PROTEIN LEVELS DURING A ONEWEEK DIVING TRIP

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Background / Objective: Diving safaris got more and more popular through the last years. It is postulated that during a scuba-dive free radicals (nitrogen-, oxygen radicals) heavily occur. Making up to four dives a days means stress for the organism. Divers do their sport to relax. Changes in carbonyl protein levels as a parameter of radical induced stress during a one-week diving trip haven't been investigated by now.
Materials and Methods: Blood samples of 25 divers were taken prior the diving trip, during the trip day one, three and five and the day after the trip. The samples were taken on site, stored as frozen centrifuged plasma. The samples (n = 125) were analyzed at the institute of medical chemistry in Graz. The data were analyzed with SPSS for windows.
Results / Discussion: The results of the Wilcoxon-Test showed that there is a relevant difference between the carbonyl protein levels throughout the week. The taken samples during and after the dive-trip were compared with the carbonyl protein-level measured before the trip. The decrease of mean is highly significant ($p < 0.002$) in each position.
Conclusions: There is no diving induced risk due to radical production during repetitive scuba-dives over the time period of one week.

P 25 CHANGES IN BLOOD PLATELET COUNT AFTER DECOMPRESSION AND CORRELATION WITH BUBBLE FORMATION

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Background: Diving and decompression stress cause changes in blood cells. Existing data in animals and humans suggest a decrease in platelet count (PC) after hyperbaric exposure, but to date no evidence exists for a dose-response relationship between the decompression and the magnitude of the observed changes in PC. This study was conducted to examine a possible link between platelet reduction and the level of venous gas emboli (VGE) after diving in field conditions.
Methods: 31 healthy volunteers divers (37.3 +/- 6 years; mean ± sem) performed an open-sea air dive to 30 m for 30 min followed by the standard French Navy decompression schedule. Repeated blood samples 1- h before and after the dive were obtained for analysis of red cells counts (RBC), hemoglobin (Hb), hematocrit (Hct) and platelet count (PC). Data were adjusted with changes in plasma volume (PV) calculated with Hb-Hct transformation equation. VGE were monitored with a pulsed Doppler on the precordial area at 30 min, 60 min et 90 min after surfacing and bubble grades were evaluated according to the Spencer scale before to be converted into Kissman integrated severity score (KISS). Spearman test was used to determine the correlation between VGE and PC.
Results: None of the divers developed any signs of decompression sickness. There was a significant increase in Hb and Hct related with haemoconcentration ($p<0.05$) and a negative correlation between bubble activity and reduction in PC ($r = - 0.51$; $p<0.01$).
Conclusion: The present study clearly shows a strong relationship between post-dive reduction in PC and VGE. This alteration could be interpreted as a platelet consumption provoked by the interaction between circulating bubbles and blood platelet, a consequently could play a potential role in the pathogenesis of decompression sickness. Further studies are needed to elucidate the underlying mechanisms of platelet activation and bubbles mechanical effects on coagulation.

P 26 A CASE REPORT OF RECURRENT ACUTE PULMONARY OEDEMA IN RECREATIONAL DIVER

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Background / Objective: Acute pulmonary oedema (APO) may be seen in severe decompression illness as well as in pulmonary barotrauma; however, isolated pulmonary oedema in diving is reported relatively infrequently (1,2%).Materials and Methods: A female instructor diver (45 yrs) experienced two episodes of pulmonary oedema following SCUBA in an interval time of six months. The case is discussed, with reference to the current literature.Results / Discussion: It is reported a case of female of 45 yrs old, diving instructor who presented two episodes of APO diving related at an interval of time of six moths between them. During the first episode Continuous Positive Airway Pressure (CPAP) was used and within 24 hours the clinical condition returned normal. After the first episode she was submitted to different medical examinations (cardio respiratory stress test, echocardio-graphy, etc.) all of them resulting negative to show any underling condition that may predispose to APO. After these examination she started again to dive and during this period she did almost 100 dives without any problem. However during a recreational dive she experienced again an APO, in this case she was treated with Furosemide iv and within few hours her clinical and hemogas conditions ameliorated markedly. Conclusions: Mechanisms that would

contribute to a raised capillary transmural pressure or to a reduced blood-gas barrier function or integrity are discussed. Pulmonary oedema in scuba divers is multifactorial, and constitutional factors may play a role. Physicians should be aware of this potential, likely underreported, problem in scuba divers.

P 27 ANALYSIS OF THE OXYGEN IN MASK

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Introduction: In the past, when the breathing mask wasn't applied tightly to the face of the patient, we used instead of it, the helmet or we even used continuous flowmeters, undergoing to in this way significant increases in environmental oxygen concentration. Indeed the helmet caused increasingly troubles in patient management during therapy. Additionally tools used for oxygen percentage measurements weren't easy to set. In this way wasn't possible data storage in order to keep a kind of archive for further evaluations. The observed value was anyway a direct validation of the breathing device performance.

Methods: Measurement tools available today (oxymeters and accessories) allow us to set:

- Measurement timing (automatic or manual)
- Alarm limits (acoustic or visual signals)
- Oxygen/air calibrations
- The stages of therapy: compression, Oxygen/air cycles, decompression, using timers and computers.

In addiction of single value measurement and visualization (main usage), percentage inhaled report during the whole treatment, represents a useful tool for further evaluations, getting eventually a cross validation looking at other tools (TcPO2). Indeed, we think is useful to keep the technical storage data for further evaluations.

Results: Through this technical monitoring, in Hyperbaric facility of Cagliari, we can get (setting up individually breathing system) oxygen levels very close to 100% of inspired gas. We didn't employ helmets anymore and continuous flow administration is employed solely for patients suffering from severe respiratory disorders.

Conclusions: The oxygen monitoring in the facemask must be employed in all hyperbaric facilities, because it represents the first evaluation about treatment quality. Oxygen monitoring is basic in hyperbaric hazard prevention. Hopefully we all wait for further technologic developments on administration flow devices, and especially for breathing devices in hyperbaric environment.

P 28 PULMONARY OEDEMA IN HYPERTENSIVE SCUBA DIVERS: CASE REPORT

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Introduction: There is a noticeable increase in the number of people interested in scuba diving, the percentage of elderly people who might be using antihypertensive medications is subsequently increasing, 6 cases presented to our center will be discussed

Materials and Methods: 6 experienced scuba divers with 300-500 logged dives, age 50-65 years, 4 males, all hypertensive, 5 of them are receiving Beta blockers and one is using Angiotensin converting enzyme inhibitor (ACE inhibitor), suffered dyspnoea and cough during a scuba dive, onset was during diving, the course was rapidly progressive upon surfacing where dyspnoea deteriorated. Regulator leakage and sea water aspiration were excluded. Dive profiles were revised. Pulse oxymetry, Electrocardiogram (ECG), Chest X ray(CXR), Complete blood count (CBC), Random Blood sugar, cardiac enzymes, liver and kidney functions were performed.

Results / Discussion: All divers/patients had in common a history of hypertension and on treatment with antihypertensive medications, ß-blockers and/or ACE inhibittors. Clinically: respiratory distress, pulmonary edema, Oxygen saturation 70-85%, ECG varies from normal to ventricular hypertrophy, CXR reveals pulmonary infiltration. All hospitalized and treated with reversal of the symptoms within 24-48 hours. All six were hypertensive and on antihypertensive medications, experienced a pulmonary edema while scuba diving with varying severity.

Conclusions: There is a possible relation between pulmonary edema and hypertensive patients on medications, therefore the effects of such treatment while scuba diving may be regarded with extreme caution as well as reconsidering the guidelines that govern the scuba diving of hypertensive patients.

P 29 A COMPARATIVE INVESTIGATION OF THE PERFORMANCE, RELIABILITY AND SAFETY OF DIVE COMPUTERS WITH AIR-DIVES

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Background / Objective: With air-only no-deco multilevel simulations, including repetitive and multiday simulations, deco-simulations (including deep stop), emergency ascents, yoyo behaviour, and extreme temperatures, the performance of dive computers (DCs) was compared mutually, with DCIEM tables and with ZH-L16C %M-values.

Materials and Methods: In 55 test-chamber sessions, 45 DCs of 27 types were examined. No-deco limits (NDLs), depths, stop depths and stop times, and no-fly times (NFTs) were logged manually per min. Part of the 226 profiles were PC-downloaded. Maximum diving depth (MDD) generally was 45 msw and 27 msw in a repetitive simulation. Decent and regular ascent speeds were 20 and 10 msw/min.

Results / Discussion: DC behaviour did not always conform with manuals, decompression theory and physiology. Two types showed irreproducible, seven oscillatory and two unexplainable inconsistency of NDL displays. Depth, time and temperature (severely delayed) were within specifications. Display ergonomics were highly variable. NDLs and NFTs of older DCs were (far) too liberal, but new DCs (1995+, with RGBM or ZH-L8ADT) were more conservative. However, with large MDDs, at deep and moderate levels all DCs were more liberal than DCIEM allowed. RGBM types became more conservative with multiday simulations. The shallower the level after a deep dive, the larger is the inter-type divergence. Some new types correct adequately for too fast ascents, others less or not at all. To extreme yo-yoing

only minor, if any, correction occurred. ZH-L8ADT DCs do compensate for refrigeration. Benefit of a deep stop feature was not confirmed. Various types implement altitude diving and "personal setting" identically.
Conclusions: The more extreme the dive profile and the larger the aberration from the rules, the greater the differences in NDLs and stop-times become, even with RGBM and ZH-L8ADT DCs. The implementation of established theory sometimes raises questions. However, for normal use modern DCs are (very) safe.

P 30 AN EXTENSION OF THE BUHL-MANN/WORKMAN-MODEL FOR APNOE DIVING

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Background: Serious DCS accidents after extensive diving in apnoea happen with increasing incidence. Thus, models to predict the likelihood of DCS are desirable. This abstract deals with an alternative model to simulate free dives and therewith to predict DCS.
Materials and Methods: The model is based on the perfusion-oriented Buhlmann/Workman model and contains it as a special case. The extended model is characterised by treating the blood flow to and through different compartments separately. Therefore, a system of delay differential equations was used. Applying the new model to some apnoeic diving profiles from the literature, verified the predictive power.
Results and Summary: The Model permits controlling the distribution of inert gas, in particular nitrogen, in the compartments with more subtlety. It is another advantage of the model that the underlying diving profile needs no change to realistically predict DCS.
Conclusion: The model -to a certain extent - can predict DCS, if appropriate data are entered. Thus, it could be useful to limit adverse consequences of either long lasting, repetitive dives or of dives to extreme depths.

P 31 CCR SAFETY: PO_2 SENSOR SIGNAL VALIDATION

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Background: Based on the readings of pO_2 sensors the partial pressure of oxygen (pO_2) inside the loop of a completely closed rebreather (CCR) is kept at a defined setpoint (O_2 injection via a solenoid or a needle valve). Nonlinearity, current limitation or just signal errors are typical sensor failures. For redundancy state of the art pO_2 sensor systems in CCR's include three sensors and a voting algorithm comparing the signals of the sensors to check for failures. This strategy tolerates the failure of one sensor, but for example cases where 2 sensors show the same signal errors cannot be detected and may lead to a life threatening deviated pO_2 inside the loop.
Materials and Methods: This paper describes a novel method for true sensor signal validation. An additional solenoid and an orifice allows injection of diluent gas directly in front of the pO_2 sensor membrane with a flow rate of approximately 2 bar l/min for a time of 5 seconds. If the sensor is working correctly the readings should correspond to the fraction of O_2 in the diluent gas and the actual depth. Additionally a third solenoid can be used to inject O_2 in the same way in front of the membrane giving an opportunity to check the sensor for linearity and current limitation.
Results / Discussion: In the first prototype the described sensor validation procedure is carried out every 120s. Short test times of just 5 s do not influence the operation of the rebreather. Sensor errors can be reliable detected thus in principle one sensor is enough for a safe ECCR control (bailout in the case of a sensor failure). Adding a second pO_2 sensor permits a safe continuation of the ECCR operation even in the case of one sensor failure.
Conclusions: Real pO_2 sensor signal validation allows reliable failure detection and even a calibration adjustment during the dive, thus offering enhanced safety in CCR diving and a better chance to avoid CCR incidents or even fatalities caused by sensor problems.

P 32 HIGH RESOLUTION ECG MONITORING DEVICE FOR RESEARCH ON VARIANCES IN THE P–QRS INTERVAL DURING BREATH HOLD DIVING

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Background / Objective: A strong decrease of the heart rate during breath hold diving can be observed in marine mammals and in elite apnoea divers. For research of variations in the ECG caused by stress conditions in general and in particular in scuba and breath hold diving ECG, recording with a high sampling rate with at least 1000Hz is required, to achieve a high resolution in the time scale. This then allows a precise measurement of the PQ-intervals and variances. Additionally, a pressure sensor for depth measurement must be integrated to have the synchronized diving profile.
Materials and Methods: The analog part consists of two ECG channels with an optional active right leg drive. First amplification is performed with 2 instrumentation amplifiers. Two 16 Bit Sigma Delta converters from Analog devices with a programmable gain stage sample at 1200 Hz. A 8 Bit RISC microprocessor reads out the AD converters and stores the data in a spreadsheet file on a SD card in FAT 16 or FAT 32 format. A 10 bar absolute pressure sensor is integrated in the lexan housing that is designed to withstand 15 bar. Its signal is digitized with one of the microcontrollers 10 Bit ADC channels. A 4x20 characters display shows status information like file name, file size and depth. Post dive data processing is performed under National Instruments Labview. A special developed software allows ECG signal filtering and analysis. Heartbeat frequency over depth, P-QRS duration over depth and P-QRS duration over heartbeat frequency are displayed.
Results / Discussion: First inwater tests were successfully carried out. Another 5 prototypes will be manufactured to

be deployed during breath hold diving championships.
Conclusions: This novel ECG monitoring device allows a simultaneous recording of depth and high resolution ECG, which is a requirement for PQ and RR analysis based on spectral analysis and chaotic nonlinear dynamics for research on the autonomous nervous system behavior that are typical under stress and hyperbaric conditions.

P 33 HBOT FOR MUSCLE INJURY IN PROFESSIONAL ATHLETES

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Background: Muscle injury affects muscular tissues, but also conjunctive and vascular tissues. A muscular tearing provokes lesions similar to an ischemia-perfusion syndrome, reason why HBOT (Hyperbaric Oxygen Therapy) properties seems to be a useful contribution. Until now, the clinical studies were only conducted on delayed-onset muscle soreness and yet only showed lack of evidence.
Materials and Methods: We treated 41 professional athletes, of which 67% were soccer players (mean age: 29 ± 10y) wounded during training or competition. They mainly came up with a lower extremities muscle injury of various grade (pulled, strained or torn muscle). Besides conventional treatment, we started with 1 to 2 HBOT sessions per day (100% O_2 at 2.7 ATA during 45 min). Mean number of sessions was 12 (range from 1 to 31).
Results: The elements of assessment were clinical: clear reduction of size of the volume of the limb and rapid lessening level of pain (spontaneous or provoked); imaging (either echography or MRI): disappeared signs of hematoma and reduced size of the lesion; shortened delay of resumption of training and quality of muscle strength.
Conclusions: Although this was not a controlled study, HBOT brought a clear improvement in the clinical symptoms as well as significant imaging findings. HBOT performed in the early stages of muscle injury provoked by intensive sport practice provides a quicker and better quality recovery, which is primary for the professional athletes (and their coach!). Unfortunately these are not willing to take part to a randomized and controlled study that has to be done imperatively.

P 34 ITU PARAMETERS IN NECROTISING SOFT ISSUE INFECTIONS ARE UNAFFECTED BY HYPERBARIC OXYGEN: AN ADULT ITU AUDIT ON 15 PATIENTS 1996-2005

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Background: There is currently debate over whether severe necrotizing soft tissue infections should be treated with hyperbaric oxygen (HBO).
Aim: To investigate whether markers of sepsis suggest HBO is effective.
Method: An audit on data from Derriford Adult ITU database was performed. Search terms included; necrotising fasciitis, Fournier's gangrene and gas gangrene. 25 cases were retrieved and 15 were found to have complete nursing ITU notes. We recorded the initial 6 hours on ITU then the HBO group underwent HBO treatment and the non-HBO group remained on ITU. A 6 hour period of time immediately following HBO or consecutively for the non-HBO group was then selected for analysis.

Results:	Pre-HBO	Post-HBO	No HBO 1st t point	No HBO 2nd t point
Age	45.09yrs		49.75yrs	
Gender	4 males - 7 females		4 males - 0 females	
Intotropes	3		5	
Pulse	99.21	97.35	82.21	86.37
Systolic BP	113.73	119.62	115.96	103.18
Diastolic BP	68.29	64.99	62.51	74.79
Pulse Gap	49.77	59.64	53.45	51.38
PH	7.28	7.29	7.32	7.23
BE	-8.21	-6.89	-8.3	-10.32
Lactate	1.78	1.81	3.5	6.76
Temp.	36.95	36.98	36.99	36.82

Discussion: No significant differences were found between groups or between time points. (Mann-Whitney U-test and Wilcoxon Sign Rank Tests) This could be because of the small group sizes; however trends indicate: 1) Those that received HBO: Base excess improved, pulse gap widened and lactate remained the same after HBO. 2) Those that did not receive HBO: The base excess and lactate worsened while the pulse gap narrowed, which would not be expected especially in the population that was more frequently treated with noradrenaline and adrenaline.
Conclusion: The metabolic acidosis of necrotising soft tissue infections may improve in the short term with hyperbaric oxygen, but a review with greater numbers of patients is required

P 35 ARE THE MOST SEVERE CASES OF NECROTISING SOFT ISSUE INFECTIONS TREATED WITH HBO? AN ADULT ITU AUDIT ON 15 PATIENTS 1996-2005

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Background: The Undersea and Hyperbaric Medical Society guidelines state that life threatening necrotising soft issue infections should be treated with hyperbaric oxygen (HBO).
Aim: To investigate whether the most severe cases received HBO.
Method: An audit on data from Derriford Adult ITU database was performed. Search terms included; necrotising fasciitis, Fournier's gangrene and gas gangrene. 25 cases were retrieved and 15 were found to have complete nursing ITU notes. We recorded demographic data and the measurements from the initial 6 hours on ITU and compared hourly pulse, systolic BP, diastolic BP and temperature and frequent pH, BE, and lactate with descriptive statistics and the non-parametric Mann-Whitney U test.
Results: Of the fifteen cases the age ranged from 5-85yrs (mean 46) with 11 of the cases being male.

Mean	HBO (N=11)	No HBO (N=4)
Age	45.09yrs	49.75yrs
Gender	4 males - 7 females	4 males - 0 females
Pulse	99.21	82.21
Systolic BP	113.73	115.96
Diastolic BP	68.29	62.51
Pulse Gap	49.77	53.45
pH	7.28	7.32
BE	-8.21	-8.30
Lactate	1.78	3.50
Temperature	37.10	37.00

Discussion: On average, in the initial 6 hours on ITU, those that had HBO had higher pulse and lower systolic BP and lower pH. However there were no significant differences between the groups on any variable.
Conclusion: There was little difference between the 2 populations; suggesting that the most severe cases are not always treated with HBO. This maybe due to the most severe cases being too ill to transport to an external hyperbaric unit. It would be interesting to compare these data with a hyperbaric unit situated within a hospital.

P 36 DOES DIVING DETORIORATE PREEXISTING DYSBARIC OSTEONECROSIS LESIONS?

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Background: Dysbaric osteonecrosis (DON) is an occupational disease of the divers and compressed air workers. DON lesions usually effect long bones, such as humerus, femur and tibia. There are two types of lesions which are classified as Type-A or Type B according to the shape and the site of localization. DON prevalence is higher in the divers who dive with the empirical techniques as Turkish sponge divers. It can be assumed that preexisting DON lesions may worsen if divers continue diving. We compared the previous and the last x-rays of three divers, who continued diving for ten years after the diagnosis of DON lesions.
Methods: The x-rays of the divers were taken and DON lesions were classified as recommended by The British Research Council; Decompression Sickness Panel. X-Rays of the same site of each diver which were taken by ten years interval were compared. Complete blood counts, ESR, serum cholesterol, triglyceride, HDL, SGOT, SGPT, uric acid, glucose level and urine analysis were performed to exclude other causes of osteonecrosis. A questionnaire was completed for each diver to get information about the dive profiles and medical histories.
Results: All of the three divers reported that they had continued diving for ten years after the diagnosis of DON was done. The divers spent an average of 22 (±8) years in the profession. The number of dives was 2 or 3 a day. The diving depths were ranged between 30 and 60 msw. We observed the previous lesions were deteriorated in ten years and the new lesions were detected on the last x-rays. Structural failure on the articular surface of humerus had developed after ten years in one of the divers.
Conclusion: The diving deteriorated the DON lesions in these 3 divers. The divers who have DON lesions should be followed up frequently or excluded from diving.

P 37 COMBINATION OF HYPERBARIC OXYGEN THERAPY AND NEGATIVE PRESSURE WOUND THERAPY IN THE MANAGEMENT OF DIABETIC WOUNDS

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Background / Objective: Lower extremity wounds are one of the most frequent and serious consequences of diabetes mellitus. Adjunctive therapies, including hyperbaric oxygen therapy and negative pressure wound therapy, are widely used in the management of diabetic wounds.
Materials and Methods: Three patients with Wagner grade 4-5 diabetic wounds were treated with hyperbaric oxygen therapy and then with negative pressure wound therapy. Hyperbaric oxygen therapy was administered at 2.4 ATA for 120 minutes in a multiplace chamber. Negative pressure wound therapy was administered for 24-48 hours 1-3 times in a week.
Results / Discussion: All patients were healed. Patients received 32-48 sessions of hyperbaric oxygen treatments and 9-15 sessions of negative pressure wound therapy. Hyperbaric oxygen therapy is beneficial to suppress infection and to relieve ischemia in diabetic wounds. When the infection is improved and the necrotic tissues were debridet negative pressure wound therapy enhances the formation of granulation tissue.
Conclusions: Because of the different effect mechanisms of adjunctive treatments methods, the appropriate time to use these methods should be considered. Combination of these methods may enhance the success rate in diabetic wound management.

P 38 DOES THE CALCULATED MAXIMAL OXYGEN UPTAKE REFLECTS THE MEASURED MAXIMAL UPTAKE CORRECTLY?

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Objective: The European Diving Technology Committee (EDTC) advises, as part of the annual examination of professional divers, to measure the maximum uptake of oxygen (VO_2-max) during exercise. This is best done by direct measurement of the VO_2-max. Alternatively the VO_2-max can be calculated by using either the formula of Jones or the formula of the American College of Sports Medicine (ACSM). Our purpose was to find out whether these formulas calculate the VO_2-max correctly.
Materials and Methods: At our centre we direct measure the VO_2-max during a maximal exercise test by using an Oxycon Alfa and Oxycon Pro device (Viasys Healthcare Inc). For this study we collect the results of the maximal exercise tests from our database from the year 2004 till 2007, which were in total 2498 exercise tests. We compared the measured VO_2-max with the VO_2-max as calculated by both formulas.
Results: We found significant differences between the measured VO_2-max and the VO_2-max as calculated by either the formula of Jones ($p<0,01$) or the ACSM-formula ($p<0,01$). Both formulas calculated a higher VO_2-max than measured.
Conclusions: Direct measurement of the VO_2-max is the international accepted standard. Indirect measurement may overestimate the fitness of the diver. If indirect measurement is used, Jones' formula will predict the VO_2-max most accurately.

P 39 INFLUENCE OF ATMOSPHERIC PRESSURE AND TEMPERATURE VARIATIONS ON INTRAOCULAR PRESSURE

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Background / Objective: It is not clear whether diving or exposure to atmospheric pressure in itself has an

influence on ocular pressure. This may be of importance when counseling persons at risk or suffering from glaucoma on their fitness to dive or hyperbaric exposures. The influence of external temperature is not known either, but it has been observed in individual patients that during hot summers, intra-ocular pressures seem to be generally higher than during the cold winter months.

Materials and Methods: 27 healthy volunteers were subjected to a standardized sequence of hyperbaric pressure increase and ambient temperature variations, in a multiplace hyperbaric chamber. Baseline measurements were done at 1 ATA 24°C, then at 2 ATA 28°C, 2 ATA 24°C, 1 ATA 24°C and finally at 1 ATA 28°C. Each exposure segment lasted 10 minutes, during the last minute of which the intra-ocular pressure (IOP) was measured with an applanation tonometer in both left eye (LE) and right eye (RE).

Results / Discussion: The mean IOP decreased from 11.8 mmHg (RE) and 11.7 mmHg (LE) at 1 ATA to 10.7mmHg (RE) and 10.3 mmHg (LE) at 2 ATA (p= 0.024 RE and p= 0.0006 LE). This IOP decrease remained constant during the whole hyperbaric exposure (50 minutes) and was independent of the temperature change. Temperature increase did not significantly influence the IOP. Systemic blood pressure and heart rate did not change during the exposure. There was no influence of the corneal thickness (as measured by pachymetry before the exposure) on the degree of pressure change.

Conclusions: In healthy young volunteers, an increase of the atmospheric pressure to 2 ATA (= diving at 10 meter below sea level) gave a small but statistically significant decrease in IOP, independent of the temperature change. This IOP decrease remained stable during the whole period of increased atmospheric pressure and was independent of blood pressure change or corneal thickness.

P 40 EDTC MEDICAL ASSESSMENT OF DIVERS: CONTROVERSIAL CASES

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Background: The aim of this work is to evaluate the appropriateness of the EDTC criteria in difficult cases in which the assessment seemed to be controversial. From the analysis of 150 medical examinations performed in 2006, regarding both recreational and commercial divers, there seem to be some inconsistencies regarding European Diving Technology Committee (EDTC) criteria for fitness to dive:

1. No known condition that limits the ability to perform the job as diver
2. No known medical condition that will jeopardize the safety of the diver or the team
3. No known medical condition that might deteriorate as a result of diving
4. No known medical condition that predisposes the diver to diving or occupational illness.

Materials and Methods: Through the analysis of some case reports, the authors focus on the medical conditions that might deteriorate as a result of diving or expose the diver to diving or occupational illness. Among these cases, that of a 59 year-old female diver, who underwent some undeserved decompression illness between 2001 and 2006, was pointed out.

Results: In the above example, as the diver presented painful skin manifestations (rash and lynphoedema), the diagnosis and therapeutic process pointed out a cardiac right to left shunt (PFO) which was closed with an intracardiac device. As the diver continued to present undeserved DCI, medical investigation revealed a pulmonary vasculitis right to left shunt.

Conclusions: The authors stress the importance to evaluate also pulmonary shunts, to add mild DCI with no neurological symptoms among the absolute contraindications to dive and to establish a protocol to resume diving after closure of PFO.

P 41 RELATIONSHIP BETWEEN BARO-TOLERANCE AND FATTY ACIDS CONSTITUTION OF BRAIN CELL MEMBRANE

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Background / Objective: One of the mechanisms for high pressure nervous syndrome (HPNS) deals with changes of cell membrane fluidity. It has known that both pressure and fatty acids constitution of cell membrane would influence membrane fluidity. Present research try to confirm that varying fraction of different fatty acids which make up cell membrane would influence HPNS.

Materials and Methods: Four groups of mice with different diet for months were compressed to 4.1MPa with He-O_2 mixture in two hours. At different stages of compression, brain stem evoked potential (BAEP) is recorded. Prolonged inter-peak latency of BAEP from wave one to wave four (IPL_{1-4}) was taken as index of occurrence of HPNS. When returned to normal pressure, animals were sacrificed and both poly unsaturated fatty acids (PUFAs) and saturated fatty acids(SFAs) of brain cell membrane were analyzed by HPLC.

Results / Discussion: On arriving at 4Mpa, the IPL1-4 of the four groups of animals were lengthened 0.294±0.400ms, 0.156±0.200ms, 0.009±0.182ms and 0.025±0.137ms separately, each corresponding to their own PUFAs percent constitution of 16.2±4.5%, 24.8±4.3%, 33.5±3.8% and 32.3±2.9% when total fatty acids were considered.

Conclusions: Varying fraction of PUFAs, implying different membrane fluidity, interfered with disturbance of synaptic transmission during hyperbaric exposure. In other words, the higher the ratio of PUFAs/SFAs of brain cell membrane, the stronger the ability for animals to counteract pressure effect. This reminds us that modified nutrition and specified medical selection for divers might become counter measures for HPNS.

P 42 HBO TREATMENT IN IATROGENIC DCI: A CASE REPORT

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Background / Objective: Oxygen at depth does act as a drug and requires accurate modulation; that has not to

lead to the misperception that 'more is better' but rather to two questions: which depth/how many times? and when have we to stop?

Materials and Methods: We'd to face an uncommon and risky use of HBO_2 in iatrogenic DCI treatment of a 12 y.o. patient, 10 days after her undergoing an operation for a second anaplastic ependimoma occurrence in the posterior cranic fossa. Any other countermeasure taken revealed itself to be ineffective in the try of shifting the bubble from its position (IV ventriculum). HBOT rational stood in the alternation of bubble collapsing and re-expanding so to be able to allow a bubble relocation; main apparent risks're the possibility noble centers went to occupy the air-displaced area and the severe central-origin bradicardia (HR:35÷40bpm) in occasional hypertension. We drew a dive profile tailored to the patient's conditions:

- air: 4'+4'+3' [two 2' patient's check stops interposed, @19.61 & 58.84-kPa, (2÷6mwc)], - 15'O_2 + 5'air + 3'O_2 @88.26-kPa (9mwc) followed by a very smooth O_2-deco to 58.84-kPa (12', 0.25mt/min) + 5'air + 20'O_2 + 5'air @58.84-kPa (to be repeated, according to symptoms and signs) + 3'O_2 @58.84-kPa (9mwc) followed by a smooth O_2-surfacing (12', 0.5mt/min).

Results / Discussion: After the first dive: bubble stable at ¼ of its starting volume; complete dislocation into an innocent and surgically deserted area @3rdTx. The actual follow-up at 30mths: no repetitive lesions, reduction of the non-ablated mass, the patient walks on her own; HBO has not affected this even somehow "lucky" evolution of the severe diagnosis of the primary disease.

Conclusions: Too risky to suggest as standard protocol but probably an idea to develop for similar undesired occurrences in neurosurgery postoperative.

P 43 DECOMPRESSION SICKNESS: HYPOTHESIS ON A PHARMACOLOGICAL TREATMENT

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Background: A limit in the decompression sickness (DCS) treatment still stands in its being a single-"drug" (hyperbaric-O_2) therapy, without a consolidated and safe adjunctive pharmacological protocol. Up to now you have always considered the problem under a self-limiting lens: focusing either upon the mere physical element directly responsible for the pathological event, where any pharmacological approach applied revealed itself to be useless, or paying attention to the sole bubble-mediated secondary effects (expecially inflammation and platelet aggregation). This has led to two drug categories with final uncertain evidence as per use and safety: cortisone and anti-aggregants/-coagulants. From DCS lymphatic and skin form occurrences, mostly observed in those women who were assuming oral contraceptives and with signs of cellulites, we derived our hypothesis: the real place where bubbles have their origin might be the connective tissue.

Objective: To find out a DCS adjunctive pharmacological strategy, if any, and rational as per application and with absence of side effects as well.

Materials and Methods: To accelerate the lymphatic circulation, to drain the extracellular compartment and to provide a better gas excess elimination while the connectival district oversaturation hasn't yet got a critical level, we used a so characterized and already existing phytotherapic: We administered 50 drops in ½ glass of water, three times a day, for three months, in 10 subjects with DCS acute progressive neurological sequelae in phase of symptoms stabilization, at least at three months from their last planned hyperbaric treatment. After 30 days we submitted the subjects an interview test and the ten persons studied underwent a complete neurological examination.

Results / Discussion: Every patient showed both subjective and objective improvements.

Conclusions: We do hope to implement these preliminary results with wider studies to verify this initial validation about the possible origin of the bubble in the connective tissue.

P 44 LYMPHOEDEMA IN FEMALE DIVERS; CASE REPORT

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Introduction: Our statistics of the previous 10 years shows clearly a higher incidence of lymphoedema in women divers as opposed to men. Lymphoedema is relatively common amongst divers, and often goes undiagnosed due to the symptoms (muscle swelling, coloration of the skin) mimicking those of trauma. In the following we will discuss five patients who presented to our facility.

Patient	Age	Certification	Last Profile	Neurogical	Respiratory
1	53	AOWD	27.5msw	+ve	+ve
2	35	Rescue Diver	25msw	+ve	+ve
3	34	AOWD	24msw	+ve	+ve
4	35	Rescue Diver	28 msw	+ve	+ve
5	39	AOWD	26.3msw	+ve	+ve

(AOWD = Advanced Open Water Diver) (+ve = positive)

Patient / Material: Five female patients with varying degrees of experience, performing different dive profiles, of different body weights and heights, suffered swelling and rash following scuba diving. The characteristic lesion is usually associated with pain that the patient describes as feeling "bruised". The most common site is the superior posterolateral aspect of the thigh and buttocks, followed by lower abdomen and lateral aspects of upper arms and breasts. On inspection there is swelling coupled with dimpling "peu d'orange" which can be exaggerated to the extent of disfiguring the upper part of the hips. Also possible is the bluish red mottling of cutis marmorata. Tenderness upon palpation, normal draining lymph nodes, negative for crepitus or surgical emphysema and no pain related to movement which can be against the muscular involvement. During a period of observation prior to recompression, the circumference of a limb is measured at regular time intervals and found to increase. The condition may be associated with joint pain and/or neurological and/or respiratory manifestations, but is also seen isolated. Some patients report difficulty dressing the following morning due to overnight weight gain of 1-2 kilograms.

Results: Treatment varies between normobaric oxygen, USNTT6 (United States Navy Treatment Table Six) and/or HBO (Hyperbaric Oxygen Sessions), rehydration and hydrotherapy with progressive improvement and full recovery within 2-7 days.

Conclusion: Lymphoedema is predominant in women, and the causes of which are still unclear. It is my opinion that thorough investigation and research work should be performed to increase our understanding.

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The **EJUHM** welcomes contributions (including letters to the Editor) on all aspects of diving and of hyperbaric medicine. Manuscripts must be offered exclusively to the **EJUHM**, unless clearly authenticated copyright exemption accompanies the manuscript. All manuscripts will be subject to peer review, with feedback to the authors. Accepted contributions will be subject to editing.

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2. Hempleman HV. History of decompression procedures. In: Bennett PB, Elliott EH, Eds. The physiology and medicine of diving. London: WB Saunders, 1993:324-375.
3. Kindwall EP, Goldmann RW. Hyperbaric medicine procedures. Milwaukee, WI: St. Luke's Medical Center, 1970.

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