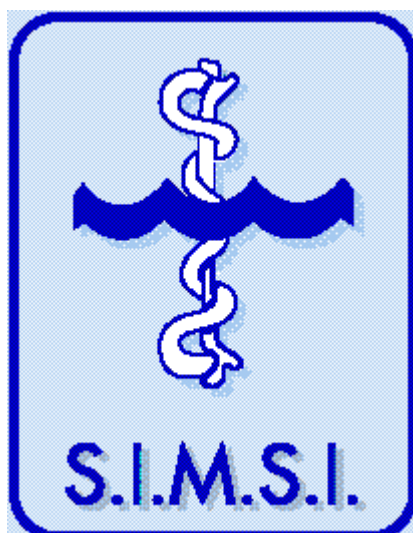


**SOCIETA' ITALIANA
DI
MEDICINA SUBACQUEA E IPERBARICA**



**RICERCA IN MEDLINE DEI LAVORI DI
MEDICINA SUBACQUEA
INDICIZZATI CON PAROLA CHIAVE**



**2005
PRIMO SEMESTRE**

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

Search "Diving"[MAJR] Limits: Publication Date from 2005/01 to 2005/06

1: Adv Exp Med Biol. 2005;566:223-9.

Benzoate hydroxylation: a measure of oxidative stress in divers.

Gronow G, Kahler W, Koch A, Klause N.

Hyperoxia may facilitate the formation of reactive oxygen species. Recent experiments indicated signs of oxidative stress after 3.5 h hyperoxic diving. We analyzed in the urine of healthy, 100% O₂-breathing male volunteers before and after 45 min seawater diving (170 kPa) or 30 min resting at 280 kPa in a pressure chamber (HBO) for sub-fractions of hydroxybenzoate (HB), monohydroxybenzoate (MHB), and of dihydroxybenzoate (DHB). Measurements were performed by HPLC and electrochemical or UV-detection. Additionally, urinary concentrations of thiobarbituric acid-reactive substances (TBARS) and of creatinine (CREA) were analyzed by standard colorimetric assays. During HBO treatment, TBARS, DHB, 2,4-DHB, and 3,4-DHB increased significantly. MHB and CREA did not change. 2,4- and 3,4-DHB-alterations correlated with changes in TBARS. Diving induced urine dilution and stimulated oxygen consumption. Urinary TBARS and HB rose significantly higher during diving at 170 kPa than during HBO at 280 kPa. A different pattern in urinary sub-fractions of DHB could be observed in divers: 2,6 > 2,3 > 2,5 > 3,4. Changes in 2,6- and 2,5-DHB correlated significantly with alterations in TBARS. 2,6-DHB probably indicated renal oxidant stress similar to previously described animal experiments. It is concluded that analyzing urinary HB may provide a sensitive measure to quantify and qualify oxidant stress in divers.

PMID: 16594156 [PubMed - indexed for MEDLINE]

2: Int Marit Health. 2005;56(1-4):188-9.

International conference on diving and hyperbaric medicine. XV International Congress of Hyperbaric Medicine (ICHM) 31st Annual Meeting of the European Underwater and Baromedical Society (EUBS) Barcelona, Spain, 7-9 September 2005.

Kot J.

PMID: 16532598 [PubMed - indexed for MEDLINE]

3: Int Marit Health. 2005;56(1-4):135-45.

Pneumoperitoneum after diving--two clinical cases and literature review.

Kot J, Sicko Z, Michalkiewicz M, Pikiel P.

National Center for Hyperbaric Medicine, Interfaculty Institute of Maritime and Tropical Medicine In Gdynia, Medical University of Gdansk, Poland. jkot@amg.gda.pl

Pneumoperitoneum after diving is a rare symptom. Diagnosis and treatment strongly depends on the primary source of the air in the abdominal cavity. There are two main sources of air entering the perineum: perforation of the gastrointestinal tract and pulmonary barotrauma. The management is different and additionally, in both cases, the decompression sickness and arterial gas embolism as consequences of inappropriate decompression phase of the diving should be included in the clinical diagnosis and treatment. The multidisciplinary team including hyperbaric physicians and surgeons is necessary for proper management of such cases. In this paper two cases of pneumoperitoneum of different origins are presented and similar cases reported in the literature are discussed.

Publication Types: Case Reports Review

PMID: 16532592 [PubMed - indexed for MEDLINE]

4: Respir Physiol Neurobiol. 2006 Feb 28;150(2-3):220-32. Epub 2005 Apr 19.

The surface activity of pulmonary surfactant from diving mammals.

Miller NJ, Daniels CB, Schurch S, Schoel WM, Orgeig S.

Environmental Biology, School of Earth and Environmental Sciences, University of Adelaide, North Tce, Adelaide, SA 5005, Australia.

Pinnipeds (seals and sea lions) have developed a specialised respiratory system to cope with living in a marine environment. They have a highly reinforced lung that can completely collapse and reinflate during diving without any apparent side effects. These animals may also have a specialised surfactant system to augment the morphological adaptations. The surface activity of surfactant from four species of pinniped (California sea lion, Northern elephant seal, Northern fur seal and Ringed seal) was measured using a captive bubble surfactometer (CBS), and compared to two terrestrial species (sheep and cow). The surfactant of Northern elephant seal, Northern fur seal and Ringed seal was unable to reduce surface tension (γ) to normal levels after 5 min adsorption (61.2, 36.7, and 46.2 \pm 1.7 mN/m, respectively), but California sea lion was able to reach the levels of the cow and sheep (23.4 mN/m for California sea lion, 21.6 \pm 0.3 and 23.0 \pm 1.5 mN/m for cow and sheep, respectively). All pinnipeds were also unable to obtain the very low γ (min) achieved by cow (1.4 \pm 0.1 mN/m) and sheep (1.5 \pm 0.4 mN/m). These results suggest that reducing surface tension to very low values is not the primary function of surfactant in pinnipeds as it is in terrestrial mammals, but that an anti-adhesive surfactant is more important to enable the lungs to reopen following collapse during deep diving.

PMID: 16476655 [PubMed - indexed for MEDLINE]

5: Can J Appl Physiol. 2005 Jun;30(3):276-81.

Increase of hemoglobin concentration after maximal apneas in divers, skiers, and untrained humans.

Richardson M, de Bruijn R, Holmberg HC, Bjorklund G, Haughey H, Schagatay E.

Dept. of Natural and Environmental Physiology, Mid Sweden University, Sundsvall, Sweden.

Human splenic contraction occurs both during apnea and maximal exercise, increasing the circulating erythrocyte volume. We investigated the hematological responses to 3 maximal apneas performed by elite apneic divers, elite cross-country skiers, and untrained subjects. Post-apnea hemoglobin concentration had increased in all groups, but especially in divers. The increases disappeared within 10 min of recovery. Apneic duration across apneas also increased the most in divers. Responses in divers could be more pronounced as a result of apnea training.

PMID: 16129892 [PubMed - indexed for MEDLINE]

6: Undersea Hyperb Med. 2005 May-Jun;32(3):175-84.

Diving behaviour and decompression sickness among Galapagos underwater harvesters.

Westin AA, Asvall J, Idrovo G, Denoble P, Brubakk AO.

Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway.

Diving conditions, dive profiles, vascular bubbles, and symptoms of decompression sickness (DCS) in a group of Galapagos commercial divers are described. They harvest sea cucumbers from small boats with surface supplied air (hookah). Dive profiles for 12 divers were recorded using dive loggers, and bubble formation was measured in the pulmonary artery. DCS symptoms were assessed by interview. A total of 380 immersions were recorded over a nine day period. The divers did on average 6.3 immersions per day, in a yo-yo pattern. Mean overall depth was 34.5 FSW. Maximum recorded depth was 107 FSW. Average bottom time per day per diver was 175 minutes. 82 % of all ascents exceeded the recommended maximum ascent rate of 30 FSW/ min. High bubble grades were observed on six occasions, but the test was unreliable. Muscle and joint pain was reported on five occasions, in three different divers. Symptoms were typically managed by analgesics, in-water recompression or not at all. The divers were extremely reluctant to seek professional help for DCS symptoms, mostly due to the high costs of treatment. We conclude that the fishermen dive beyond standard no-decompression limits, and that DCS symptoms are common.

PMID: 16119309 [PubMed - indexed for MEDLINE]

7: Undersea Hyperb Med. 2005 May-Jun;32(3):169-74.

Dysbaric osteonecrosis by X-ray and CT scan in Chinese divers.

Jiang CQ, Wang B, Yu CF, Xiao LW, Liu WW, Jiao SH, Liu YY, Lao XQ, Lam TH.

Guangzhou Occupational Disease Prevention & Treatment Centre, Guangzhou 510620, China.

OBJECTIVE: To compare the results of X-ray and CT scan for dysbaric osteonecrosis in Chinese divers.

METHODS: Both shoulders, hips and knees of 66 asymptomatic divers with diving duration of more than one year were examined by X-ray and CT scan.

RESULTS: The most frequent locations of dysbaric osteonecrosis were the upper femurs, followed by the upper humerus, lower femurs and upper tibias, and the most frequent radiographic lesions were calcification spots and cystic changes. Of the lesions detected, 38% (27/71) and 42% (95/229) werejuxta-articular of the femoral and humeral heads by X-ray and CT respectively. The detection rates of dysbaric necrosis (juxta- and/or other lesions) of X-ray and CT scan were 42.4% (95% confidence interval: 30.5%-54.3%) and 81.8% (95% CI: 72.4%-91.2%) respectively (p<0.05). If CT scan was used as the gold standard, the sensitivity of X-ray was 100% and the specificity was 31.6%. CONCLUSION: CT scan showed a higher detection rate of dysbaric necrosis than X-ray. We recommend that CT scan be used for early diagnosis of dysbaric osteonecrosis.

Publication Types: Evaluation Studies

PMID: 16119308 [PubMed - indexed for MEDLINE]

8: Isr Med Assoc J. 2005 Jun;7(6):406-7.

Carotid artery dissection after scuba diving.

Skurnik YD, Sthoeger Z.

Department of Internal Medicine B, Kaplan Medical Center, Rehovot, Israel. jair_skurnik@hotmail.com

Publication Types: Case Reports

PMID: 15984390 [PubMed - indexed for MEDLINE]

9: J Physiol. 2005 Aug 1;566(Pt 3):901-6. Epub 2005 Jun 16.

A single air dive reduces arterial endothelial function in man.

Brubakk AO, Duplancic D, Valic Z, Palada I, Obad A, Bakovic D, Wisloff U, Dujic Z.

Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway. alfb@ntnu.no

During and after decompression from dives, gas bubbles are regularly observed in the right ventricular outflow tract. A number of studies have documented that these bubbles can lead to endothelial dysfunction in the pulmonary artery but no data exist on the effect of diving on arterial endothelial function. The present study investigated if diving or oxygen breathing would influence endothelial arterial function in man. A total of 21 divers participated in this study. Nine healthy experienced male divers with a mean age of 31 +/- 5 years were compressed in a hyperbaric chamber to 280 kPa at a rate of 100 kPa min(-1) breathing air and remaining at pressure for 80 min. The ascent rate during decompression was 9 kPa min(-1) with a 7 min stop at 130 kPa (US Navy procedure). Another group of five experienced male divers (31 +/- 6 years) breathed 60% oxygen (corresponding to the oxygen tension of air at 280

kPa) for 80 min. Before and after exposure, endothelial function was assessed in both groups as flow-mediated dilatation (FMD) by ultrasound in the brachial artery. The results were compared to data obtained from a group of seven healthy individuals of the same age who had never dived. The dive produced few vascular bubbles, but a significant arterial diameter increase from 4.5 +/- 0.7 to 4.8 +/- 0.8 mm (mean +/- s.d.) and a significant reduction of FMD from 9.2 +/- 6.9 to 5.0 +/- 6.7% were observed as an indication of reduced endothelial function. In the group breathing oxygen, arterial diameter increased significantly from 4.4 +/- 0.3 mm to 4.7 +/- 0.3 mm, while FMD showed an insignificant decrease. Oxygen breathing did not decrease nitroglycerine-induced dilatation significantly. In the normal controls the arterial diameter and FMD were 4.1 +/- 0.4 mm and 7.7 +/- 0.2.8%, respectively. This study shows that diving can lead to acute arterial endothelial dysfunction in man and that oxygen breathing will increase arterial diameter after return to breathing air. Further studies are needed to determine if these mechanisms are involved in tissue injury following diving.

Publication Types: Clinical Trial Controlled Clinical Trial

PMID: 15961424 [PubMed - indexed for MEDLINE]

10: Diabetes Metab. 2005 Apr;31(2):144-51.

Blood glucose changes and adjustments of diet and insulin doses in type 1 diabetic patients during scuba diving (for a change in French regulations).

Lormeau B, Sola A, Tabah A, Chiheb S, Dufaitre L, Thurninger O, Bresson R, Lormeau C, Attali JR, Valensi P.

Service d'endocrinologie-diabetologie-nutrition, Hopital Jean Verdier, AP-HP, BONDY, France.

OBJECTIVE: In France, diabetic subjects were not allowed to dive. The principal risk is hypoglycemia during immersion. However scuba diving is allowed in many countries. To follow blood glucose changes, food intake and insulin adjustments in type 1 diabetic patients when diving, and to propose specific guidelines for such patients willing to practice recreational scuba diving. **METHODS:** Fifteen well-controlled (mean HbA1c: 7.2%) type 1 diabetic patients without complications were volunteer to dive under strict medical monitoring. They dove 8 times in 4 days in autumn at a depth of 20 meters, in 12 degrees C to 16 degrees C water. A strict protocol based on blood glucose was implemented to prevent hypoglycaemia. **RESULTS:** No case of hypoglycemia was observed and no faintness was reported underwater. Mean blood glucose before diving was 200 mg/dl (11 mmol/l). There was a mean fall in blood glucose of 40 mg/dl (2.2 mmol/l) during dives, a mean decrease in daily insulin doses by 19.3% on the last day. Daily energy intake was 3,225 Kcal in average. A continuous glucose monitoring (CGMS) was performed in one patient and showed a rather stable glycemia during immersion but a decrease within the 8 hours after. **CONCLUSION:**

When respecting a strict protocol to prevent hypoglycaemia, the risk of hypoglycaemia appears quite low. We recommend an ideal glycemic goal of 200-250 mg/dl (11-13.75 mmol/l) before immersion, a higher reduction of insulin doses (-30%) and taking carbohydrates on board in any case. The present data have recently led the French diving federation (FESSM) to allow type 1 diabetic patients to dive with some restrictive qualification requirements: dives within the "safety curve" (no decompression curve), in above 14 degrees C water, depth limited to the median space range (6 to 20 meters), plus mandatory guidance by a diving instructor.

PMID: 15959420 [PubMed - indexed for MEDLINE]

11: Physiol Biochem Zool. 2005 Jul-Aug;78(4):482-90. Epub 2005 May 24.

Development of the blood and muscle oxygen stores in gray seals (*Halichoerus grypus*): implications for juvenile diving capacity and the necessity of a terrestrial postweaning fast.

Noren SR, Iverson SJ, Boness DJ.

Conservation and Research Center, National Zoological Park, Smithsonian Institution, Washington, DC 20008, USA. shawn.noren@noaa.gov

To successfully transition from nursing to foraging, phocid seal pups must develop adequate diving physiology within the limited time between birth and their first independent foraging trip to sea. We studied the postpartum development of oxygen stores in gray seals (*Halichoerus grypus*, n=40) to better understand the ontogeny of diving capacity in phocids. Hemoglobin (Hb), hematocrit (Hct), blood volume (BV), and myoglobin (Mb) levels in newborn (3 d postpartum [DPP]) and newly weaned (17+/-0.4 DPP) pups were among the lowest measured across age classes. During the pups' terrestrial postweaning fast (PWF), Hb, Hct, mass-specific BV, and Mb increased by 28%, 21%, 13%, and 29%, respectively, resulting in a 35% increase in total body mass-specific oxygen stores and a 23% increase in calculated aerobic dive limit (CADL). Although Hb and Hct levels at the end of the PWF were nearly identical to those of yearlings, total body mass-specific oxygen stores and CADL of weaned pups departing for sea were only 66%-67% and 32%-62%, respectively, of those for yearlings and adult females. The PWF represents an integral component of the physiological development of diving capacity in phocids; however, newly independent phocids still appear to have limited diving capabilities at the onset of foraging.

PMID: 15957103 [PubMed - indexed for MEDLINE]

12: Eur J Appl Physiol. 2005 Aug;94(5-6):646-51. Epub 2005 Jun 8.

Studies on inspiratory and expiratory glossopharyngeal breathing in breath-hold divers employing magnetic resonance imaging and spirometry.

Lindholm P, Nyren S.

Section of Environmental Physiology, Department of Physiology and Pharmacology, Karolinska Institutet, Berzelius vag 13, 171 77 Stockholm, Sweden. peter.lindholm@fyfa.ki.se

Competitive breath-hold divers use glossopharyngeal breathing in order to increase their performance. Glossopharyngeal inhalation (GI) increases the volume of air in the lungs above the total lung capacity, thereby increasing the volume of gas available for pressure equalization at great depth. The reverse procedure, glossopharyngeal exhalation (GE), is used to suck air out of the lungs at great depth when the lungs are compressed, thus providing air in the mouth for equalization of pressure in the middle ear. Five Swedish apnea athletes were tested. Their vital capacity (VC) and the volume of air exhaled after GI were measured with a turbine spirometer, while the residual volume (RV), and the volume of gas in the lungs following GE was determined using a helium dilution procedure. Thereafter subjects performed these maneuvers during magnetic resonance imaging (MRI) of the thorax. All subjects exhibited a higher VC + GI (7.8-11.9l) than VC (6.2-9.5l) and lower RV-GE (1.16-1.77l) than RV (1.37-2.40l). MRI revealed pronounced changes in the volume of intrathoracic blood, with a small heart and compressed vessels following GI and the opposite, i.e., enlarged vessels during GE. MRI also showed an invagination of the posterior wall of the trachea, in connection with GE in certain subjects.

Publication Types: Clinical Trial

PMID: 15942772 [PubMed - indexed for MEDLINE]

13: J Exp Biol. 2005 Jun;208(Pt 12):2207-16.

Regulation of stroke and glide in a foot-propelled avian diver.

Watanuki Y, Takahashi A, Daunt F, Wanless S, Harris M, Sato K, Naito Y.

Graduate School of Fisheries Sciences, Hokkaido University, Minato-cho 3-1-1, Hakodate, Hokkaido, 041-8611, Japan. ywata@fish.hokudai.ac.jp

Bottom-feeding, breath-hold divers would be expected to minimize transit time between the surface and foraging depth, thus maximizing the opportunities for prey capture during the bottom phase of the dive. To achieve this they can potentially adjust a variety of dive parameters, including dive angle and swim speed. However, because of predictable changes in buoyancy with depth, individuals would also be expected to adjust dive behavior according to dive depth. To test these predictions we deployed miniature, dorsally attached data-loggers that recorded surge and heave accelerations at 64 Hz to obtain the first detailed measurements of a foot-propelled diving bird, the European shag *Phalacrocorax aristotelis*, in the wild. The results were used to investigate biomechanical changes during the descent, ascent and bottom phases for dives varying between 7 m and 43 m deep. Shags descended and ascended almost vertically (60-90 degrees relative to the sea surface). During descent, swim speed varied between 1.2-1.8 m s(-1) and the

frequency of the foot stroke used for propulsion decreased significantly with depth, mainly due to a fivefold increase in the duration of the glide between strokes. Birds appeared to maintain the duration and the maximum strength of power stroke and thus optimize muscle contraction efficiency.

PMID: 15939764 [PubMed - indexed for MEDLINE]

14: Ned Tijdschr Tandheelkd. 2005 May;112(5):188-9.

[Sports and oral health on line 2]

[Article in Dutch]

Liem SL.

Scuba diving is accompanied by some risks. This article deals with some websites about the safety and health of scuba divers. Informative websites are those of the Divers Alert Network and the Dutch Society of Scuba Diving Medicine ('Nederlandse Vereniging voor Duikgeneeskunde').

PMID: 15932048 [PubMed - indexed for MEDLINE]

15: Ned Tijdschr Tandheelkd. 2005 May;112(5):168-72.

[Oral problems in divers]

[Article in Dutch]

Scheper WA, Lobbezoo F, Eijkman MA.

Uit de sectie Sociale Tandheelkunde en Voorlichtingskunde en Academisch Centrum Tandheelkunde Amsterdam.

Divers can have several oral problems. Firstly, problems caused by pressure changes. These are barodontalgia and odontocrexia. Barodontalgia is toothache by barotrauma. Odontocrexia is restorations coming loose or breaking or tooth fractures by expansion of air beneath restorations. Other problems can occur by cements used to fix casted restorations, by inflammations in the orofacial region, and by not yet fully healed oral wounds. Secondly, there are problems related to the diver's mouthpiece. To keep the mouthpiece in place, the mandible has to be forced in a forward position. Holding this position often and for long periods of time, may develop or aggravate temporomandibular dysfunction. Insufficient fit of the mouthpiece may induce oral mucosal lesions. Therefore, it is recommended to produce individual diver mouthpieces. It is also recommended to produce individual diver mouthpieces for complete dentures wearing divers and for divers with fixed orthodontic appliances.

Publication Types: Review

PMID: 15932043 [PubMed - indexed for MEDLINE]

16: Ned Tijdschr Tandheelkd. 2005 May;112(5):162-7.

[Problems of the head and neck region in divers]

[Article in Dutch]

Feenstra L.

Uit de afdeling Keel-, Neus-, Oorheelkunde van het Erasmus Medisch Centrum te Rotterdam. l.feenstra@erasmusmc.nl

For understanding the problems in the head and neck region of divers, knowledge of some physical laws is needed. Primarily, problems of diving are related to barotrauma: tissue-damage by pressure. The most frequent problems encountered with diving are problems in closed cavities, such as in ears, teeth, and sinuses. Other problems occurring are those of temporomandibular joints, facial nerves, and oral mucosal tissues.

Publication Types: Review
PMID: 15932042 [PubMed - indexed for MEDLINE]

17: Med Clin (Barc). 2005 May 28;124(20):795-6.
[Osteomyelitis by *Pseudomonas aeruginosa* in a submariner]

[Article in Spanish]
Garcia J, Monfort J, Blanch J, Benito P.
Publication Types: Case Reports Letter
PMID: 15927108 [PubMed - indexed for MEDLINE]

18: Undersea Hyperb Med. 2005 Mar-Apr;32(2):135-9.

Sonar versus whales: noise may disrupt neural activity in deep-diving cetaceans.

Talpalar AE, Grossman Y.
Department of Physiology, Faculty of Health Sciences, Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel.
PMID: 15926306 [PubMed - indexed for MEDLINE]

19: Undersea Hyperb Med. 2005 Mar-Apr;32(2):129-33.

U.S. navy diver/aviator/skydiver with AGE from a previously unknown PFO.

Wyland J, Krulak D.
Naval Hospital Pensacola, USA.

A 32 year old US Naval aerospace physiologist with dive, jump and flight qualifications presented to a US Navy hyperbaric medicine department complaining of nausea, unsteadiness and left hand and forearm paresthesia that began almost immediately after completing a 28ft/ 40min recreational dive. Following an abbreviated history and physical examination the patient was diagnosed to be suffering from an arterial gas embolism. He was treated with hyperbaric therapy during which his symptoms resolved. Follow-on transesophageal echocardiography revealed an atrial septal aneurysm with a patent foramen ovale resulting in a right-to-left shunt after Valsalva maneuver, but no evidence of ventricular dysfunction, wall motion abnormalities, or abnormal ejection. His episode was attributed to paradoxical air embolism and he was disqualified from further special duty. In order to regain his dive, jump and flight qualifications, the patient elected to undergo repair of the cardiac defect with a device that is relatively new in the operational military setting. The procedure was a success, he was granted waivers for his prior qualifications, and remains in that status to this day. This is the first known case where an

atrial septal occluder has been used to preserve these special duty qualifications.

Publication Types: Case Reports
PMID: 15926305 [PubMed - indexed for MEDLINE]

20: Undersea Hyperb Med. 2005 Mar-Apr;32(2):85-8; author reply 89-92.

Erratum in: Undersea Hyperb Med. 2005 May-Jun;32(3):following table of contents.

Comment on: Undersea Hyperb Med. 2004 Summer;31(2):233-43.

A deep stop during decompression from 82 fsw (25m) significantly reduces bubbles and fast tissue gas tensions.

Risberg J, Brubakk A.
Publication Types: Comment Letter
PMID: 15926299 [PubMed - indexed for MEDLINE]

21: Neuroradiology. 2005 Jun;47(6):411-6. Epub 2005 May 20.

Fatal scuba diving incident with massive gas embolism in cerebral and spinal arteries.

Ozdoba C, Weis J, Plattner T, Dirnhofer R, Yen K.
Institute of Diagnostic and Interventional Neuroradiology, Inselspital, University of Bern, Switzerland.

CT and MRI have the potential to become useful adjuncts to forensic autopsy in the near future. The examination of fatal injuries facilitates a profound experience in the clinical-radiological examination of these cases; the more severe findings in corpses with autopsy verification can help one to understand the tiny signs seen in clinical cases of surviving victims. We present the case of a 44-year-old male diver who died from severe decompression sickness after rapid ascent from approximately 120 m. Post-mortem CT and MRI studies of the brain and spinal cord revealed extensive gas inclusions in cerebral arteries, spinal arteries and cerebrospinal fluid (CSF) spaces, while the intracranial venous sinuses remained unaffected. These findings were confirmed at autopsy. Appropriate imaging techniques can help forensic pathologists to aim their autopsies at findings that might otherwise remain undetected.

Publication Types: Case Reports
PMID: 15906021 [PubMed - indexed for MEDLINE]

22: J Acoust Soc Am. 2005 Apr;117(4 Pt 1):2291-300.

Measurement of the depth-dependent resonance of water-loaded human lungs.

Martin JS, Rogers PH, Cudahy EA.
School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0405, USA.

An experiment was conducted to determine the response of the human lung to water-borne sound in the range of 20 to 500 Hz. A small pool inside a hyperbaric chamber was used to simulate four ambient pressure conditions spanning the range of recreational diving depths. Ten subjects were tested on two occasions each using three separate measures to evaluate the response of the subjects' lungs. With

some notable exceptions, results were consistent between subjects and between measures. These indicate that human lungs can be reasonably modeled as a lumped single-degree-of-freedom system over the lower portion of the band of interest. Here, the surrounding fluid provides the dominant mass and the dominant stiffness is provided by the entrapped air with a small additional contribution from tissue elasticity. Measured resonances increase with the square root of ambient pressure from an average of 40 Hz with a quality factor of 1.8 at near-surface pressure to 73 Hz with a quality factor of 2.6 at an equivalent depth of 36.4 m. There is evidence of other resonances within or near the band of interest that may be attributable to nonvolumetric chest/lung modes, Helmholtz resonance, and/or resonance of gastrointestinal bubbles.

PMID: 15898669 [PubMed - indexed for MEDLINE]

23: *Aviat Space Environ Med.* 2005 May;76(5):490-2.

Bubble incidence after staged decompression from 50 or 60 msw: effect of adding deep stops.

Blatteau JE, Hugon M, Gardette B, Sainty JM, Galland FM.

CEMPP, Toulon Naval, France.
je.blatteau@infonie.fr

OBJECTIVES: The French Navy uses the Marine Nationale 90 (MN90) decompression tables for air dives as deep as 60 msw. The resulting incidence of decompression sickness (DCS) for deep dives (45-60 msw) is one case per 3000 dives. **METHODS:** Three protocols with experimental ascent profiles (EAPs) were tested in the wet compartment of a hyperbaric chamber. For each protocol, eight subjects dove to 50 or 60 msw and ascended according to the standard MN90 table or an EAP. Precordial bubbles were monitored with Doppler sensors at 30-min intervals after surfacing. Protocol I went to 60 msw and used deep stops beginning at 27 msw. Protocol II was a repetitive dive to 50 msw with a 3-h surface interval; the EAP made the first deep stop at 18 msw. Protocol III again went to 60 msw, but the EAP used a single, shorter deep stop at 25 msw. **RESULTS:** For Protocol I, all divers developed bubbles at Spencer grade 2-3 and still had bubbles 120 min after surfacing; there was no statistical difference between bubbling for the MN90 and EAP, but one diver presented a case of DCS after the EAP. For Protocol II, the EAP produced severe bubbling for the eight divers. Those findings led to stopping the EAPs with the longer deep stops used in Protocols I and II. Protocol III again showed no difference between the standard and modified profiles. **DISCUSSION:** The addition of deep stops requires careful consideration. Two of our EAPs made no difference and one produced increased bubbling.

Publication Types: Clinical Trial

PMID: 15892549 [PubMed - indexed for MEDLINE]

24: *AJNR Am J Neuroradiol.* 2005 May;26(5):1218-9.

Barotrauma presenting as temporal lobe injury secondary to temporal bone rupture.

Cortes MD, Longridge NS, Lepawsky M, Nugent RA.

Department of Radiology, Vancouver General Hospital, Vancouver, British Columbia, Canada.

We present the case of a scuba diver who experienced acute ear pain during ascent from a dive. CT imaging was performed because of severe unrelenting headache. Blood and gas was identified within the epidural space of the middle fossa and over the petrous bone, as well as hemorrhage within the adjacent temporal lobe. To the best of our knowledge, this is the first case of CT-documented barotrauma affecting the brain as a result of middle-ear gas rupturing through the tegmen tympani.

Publication Types: Case Reports

PMID: 15891187 [PubMed - indexed for MEDLINE]

25: *J Exp Biol.* 2005 May;208(Pt 10):1971-91.

Physiological control of diving behaviour in the Weddell seal *Leptonychotes weddelli*: a model based on cardiorespiratory control theory.

Stephenson R.

Department of Zoology, University of Toronto, Toronto, Ontario, Canada M5S 3G5.
rstephns@zoo.utoronto.ca

Despite being obligate air breathers, many species of marine mammal are capable of spending most of their lives submerged in water. How they do this has been a subject of intense interest to physiologists for over a century, yet we still do not have a detailed understanding of the physiological mechanisms underlying this behaviour. What are the proximate mechanisms that trigger the 'decisions' to submerge and return to the surface? The present study proposes a model intended to address this question, based on fundamental concepts of cardiorespiratory control. Two basic hypotheses are examined by computer simulation, using a mathematical model of the mammalian cardiorespiratory control system with parameter values for an adult Weddell seal: (1) that the control of diving can be considered to be a respiratory control problem, and (2) that dives are initiated and maintained by disfacilitation of respiratory drive, not inhibition. Computer simulations confirmed the plausibility of these hypotheses. Simulated diving behaviour and physiological responses (ventilation, cardiac output, blood and tissue gas tensions) were consistent with published data from freely diving Weddell seals. Dives up to the estimated aerobic dive limit (ADL, 18-25 min) could be simulated without the need for active inhibition of breathing in this model. This theoretical analysis suggests that the most important physiological adjustments occur during the surface interval phase of the dive cycle and include hyperventilation accompanied by high cardiac output, appropriate regulation of cerebral blood flow and central chemoreceptor threshold shifts. During dives, cardiac output, distribution of peripheral blood flow, splenic contraction and peripheral chemoreflex drives

were found to modulate physiological and behavioural responses, but were not essential for simulated dives to occur. The main conclusion from this study is that the central chemoreceptor may be an important mechanism involved in the regulation of diving behaviour, implying that CO₂, not O₂, is the key regulatory variable in this model. This model includes and extends the ADL concept and suggests an explicit mechanism by which the respiratory control system may play a central role in the regulation of diving behaviour. It is likely that respiratory mechanisms are an important component of a hierarchical behavioural control system and further studies are required to test the qualitative and quantitative validity of the model.

PMID: 15879077 [PubMed - indexed for MEDLINE]

26: Br J Sports Med. 2005 May;39(5):e24.

Acute effects of a single open sea air dive and post-dive posture on cardiac output and pulmonary gas exchange in recreational divers.

Dujic Z, Bakovic D, Marinovic-Terzic I, Eterovic D. School of Medicine, University of Split, Soltanska 2, Split 21000, Croatia. zdujic@bsb.mefst.hr

OBJECTIVE: To evaluate the cardiopulmonary effects of open sea scuba air diving to 39 m (30 minutes bottom time) with standard decompression. To account for possible gravity dependent effects of venous gas bubbles, the variables were measured in different post-dive body postures and compared with the baseline values before the dive in the same posture. **METHODS:** Eight male divers conducted two similar dives on successive days. Their posture before and after the dive was either sitting or supine, in random order. The divers were evaluated before and 30, 60, and 90 minutes after the dive. Venous bubbles were detected by precordial Doppler after the dive in four divers in the supine posture and two divers in the sitting posture. **RESULTS:** Arterialised oxygen tension had decreased at all times after the dive (-11.3 mm Hg, $p = 0.00006$), due to decreased alveolar oxygen tension, irrespective of posture. Apart from an increase in the sitting posture 30 minutes after the dive, pulmonary capacity for carbon monoxide diffusion and cardiac index decreased, mostly 60 minutes after the dive (-9%, $p = 0.0003$ and -20%, $p = 0.0002$ respectively). The decrease in cardiac index was greater in the supine posture ($p = 0.0004$), and the physiological dead space/tidal volume ratio increased more in the sitting position ($p = 0.006$). **CONCLUSIONS:** Field dives are associated with moderate impairments in cardiac output and gas exchange. Some of these impairments appear to depend on the posture of the diver after the dive.

Publication Types: Clinical Trial Randomized Controlled Trial

PMID: 15849277 [PubMed - indexed for MEDLINE]

27: J Appl Physiol. 2005 Sep;99(3):944-9. Epub 2005 Apr 21.

Exercise-induced intrapulmonary shunting of venous gas emboli does not occur after open-sea diving.

Dujic Z, Palada I, Obad A, Duplancic D, Brubakk AO, Valic Z.

Dept. of Physiology and Biophysics, Univ. of Split School of Medicine, Soltanska 2, 21000 Split, Croatia. zdujic@bsb.mefst.hr

Paradoxical arterializations of venous gas emboli can lead to neurological damage after diving with compressed air. Recently, significant exercise-induced intrapulmonary anatomical shunts have been reported in healthy humans that result in widening of alveolar-to-arterial oxygen gradient. The aim of this study was to examine whether intrapulmonary shunts can be found following strenuous exercise after diving and, if so, whether exercise should be avoided during that period. Eleven healthy, military male divers performed an open-sea dive to 30 m breathing air, remaining at pressure for 30 min. During the bottom phase of the dive, subjects performed mild exercise at approximately 30% of their maximal oxygen uptake. The ascent rate was 9 m/min. Each diver performed graded upright cycle ergometry up to 80% of the maximal oxygen uptake 40 min after the dive. Monitoring of venous gas emboli was performed in both the right and left heart with an ultrasonic scanner every 20 min for 60 min after reaching the surface pressure during supine rest and following two coughs. The diving profile used in this study produced significant amounts of venous bubbles. No evidence of intrapulmonary shunting was found in any subject during either supine resting posture or any exercise grade. Also, short strenuous exercise after the dive did not result in delayed-onset decompression sickness in any subject, but studies with a greater number of participants are needed to confirm whether divers should be allowed to exercise after diving.

Publication Types: Clinical Trial

PMID: 15845772 [PubMed - indexed for MEDLINE]

28: Am J Phys Med Rehabil. 2005 May;84(5):369-75.

SCUBA diving for individuals with disabilities.

Cheng J, Diamond M.

University of Medicine and Dentistry of New Jersey-New Jersey Medical School, Newark, New Jersey, USA.

Self-contained underwater breathing apparatus (SCUBA) diving has become an increasingly popular recreational activity, enjoyed by millions of individuals. There has also been a growing interest in SCUBA diving in the disabled population for rehabilitation and recreation. This review discusses medical issues relevant to individuals with disabilities who wish to participate in SCUBA diving. In addition, specialized equipment, adaptations in techniques, and additional precautions will be presented. SCUBA diving can be an enriching experience, potentially helping to improve self-image and quality of life. Knowledgeable healthcare

professionals can help to guide their patients who are interested in SCUBA diving.

Publication Types: Case Reports Review
PMID: 15829784 [PubMed - indexed for MEDLINE]

29: *Aviat Space Environ Med.* 2005 Apr;76(4):366-9. Hearing thresholds among young professional divers: a 6-year longitudinal study.

Skogstad M, Haldorsen T, Arnesen AR, Kjuus H. National Institute of Occupational Health, Oslo, Norway. Marit.Skogstad@stami.no

INTRODUCTION: Diving is associated with pressure effects and noise exposure that can impair hearing. We were interested in finding out whether changes in hearing thresholds were related to cumulative exposure in young professional divers. **METHODS:** In a prospective follow-up design, we studied a cohort of 47 men from the beginning of their education as professional divers at a mean age of 25.6 yr (range 18-38 yr). They had audiograms taken at baseline, after 1 and 3 yr, and finally after 6 yr, during which they performed 40-1458 (median 184) sea dives, most of them to a depth of 10 m or less. The hearing tests measured pure tone air conduction thresholds at 0.25-8.0 kHz in a sound-treated booth. Annual change of hearing thresholds were calculated by fitting linear regression lines to individual data. For purposes of analysis, the divers were divided into two groups, low-exposure (199 or fewer dives, n = 26) and high-exposure (200 or more dives, n = 21). **RESULTS:** Hearing was better in the divers than in the general population at baseline and follow-up. At 6 yr, significant reductions were found in the divers' hearing at 4 kHz and 8 kHz. Significant increases in thresholds were found at 0.5, 2, 3, and 6 kHz for the right ear and 3, 4, and 6 kHz for the left ear. The annual change at 4 kHz was 0.95 dB in the left ear and 0.18 dB in the right ear (p = 0.01). There was no significant difference in hearing changes between the high- and low-exposure groups. **DISCUSSION:** The results suggest that a mild hearing impairment can occur in young professional divers due to occupational and other noise exposure. PMID: 15828636 [PubMed - indexed for MEDLINE]

30: *Aviat Space Environ Med.* 2005 Apr;76(4):326-8. Exercise ending 30 min pre-dive has no effect on bubble formation in the rat.

Berge VJ, Jorgensen A, Loset A, Wisloff U, Brubakk AO.

Department of Circulation and Medical Imaging, Faculty of Medicine, NTNU, Trondheim, Norway. vegardbe@stud.ntnu.no

INTRODUCTION: We have previously shown that exercise performed 20 h before a dive significantly reduces bubble formation in both rats and humans. Furthermore, exercise performed closer to the dive did not prevent bubble formation. **HYPOTHESIS:** The present study was designed to determine whether exercise 30 min prior to a dive promotes bubble formation. The occurrence of many bubbles is linked to a higher risk of developing decompression

sickness. **METHODS:** A total of 58 Sprague-Dawley rats were randomly divided into a sedentary control group (n = 29) and an exercise group (n = 29). Rats in the exercise group ran on a treadmill for a total of 90 min at variable intensity up to 85-90% of VO₂max. Then, 30 min after exercise, one rat from each group rested in a pressure chamber at 700 kPa (7 atm) breathing air, performing a simulated dive. Bottom time was 45 min; decompression rate was 50 kPa x min⁻¹ (0.5 atm x min⁻¹). Immediately after surfacing (100 kPa, 1 atm), the rats were anesthetized and bubbles were measured discontinuously for the next 60 min. **RESULTS:** There were no significant differences in survival (p = 0.55), median bubble grade (p = 0.67), survival time (p = 0.53), or the number of rats getting a bubble score > or = 2 (p = 0.79) between the groups. **CONCLUSION:** The same type and intensity of exercise that reduces bubble formation when performed 20 h prior to a dive neither promotes nor reduces bubble formation if performed 30 min before a dive. The present data indicate that exercise completed 30 min before a dive does not increase the risk of developing decompression sickness in the rat.

PMID: 15828630 [PubMed - indexed for MEDLINE]

31: *Undersea Hyperb Med.* 2005 Jan-Feb;32(1):39-44.

Pulmonary edema in scuba divers: recurrence and fatal outcome.

Cochard G, Arvieux J, Lacour JM, Madouas G, Mongredien H, Arvieux CC.

Unite de soins hyperbares, Departement d' Anesthesie-Reanimation, CHU de Brest, Hopital de la Cavale Blanche, Boulevard Tanguy Prigent, 29609 Brest, France.

Pulmonary edema occurring in divers using a self-contained underwater breathing apparatus (scuba) is an uncommon, probably under-reported, but potentially life-threatening and recurrent condition. We report six episodes of pulmonary edema in five scuba divers seen during a period of 15 months. The four men and one woman ranged in age from 37 to 56 years and two were treated for hypertension. Symptoms were mostly dyspnea onset at depth, cough, hemoptysis and hypoxemia, which in the recurrent case led to cardiac arrest and death. All cases occurred in rather cold water. Findings on thoracic computed tomography (CT) scanning ranged from pleural effusion to ground-glass opacities restricted to a few areas of the lung. The complex underlying mechanisms that would contribute to a raised transalveolar pressure or to a disruption of the blood-gas barrier are discussed. It is important for emergency care providers to be aware of this syndrome for prompt recognition and optimal treatment.

Publication Types: Case Reports Review
PMID: 15796313 [PubMed - indexed for MEDLINE]

32: *Undersea Hyperb Med.* 2005 Jan-Feb;32(1):27-37.

Scuba diving with diabetes mellitus--the UK experience 1991-2001.

Edge CJ, St Leger Dowse M, Bryson P.

The Stone Barn, Gravel Lane, Drayton, Abingdon, Oxon UK.

OBJECTIVES: To survey the outcomes and practises of divers with diabetes mellitus. **METHODS:** Diabetic persons wishing to learn to scuba-dive or established divers who have diabetes mellitus in the UK are requested to fill in a detailed questionnaire annually. Divers are asked to provide basic epidemiological information and general diving history. Data provided by the diver's diabetic physician provided independent evidence of the diver's medical status. These data are recorded and analysed. **RESULTS:** Data have been gathered from 323 diabetic divers (269 male, 54 female) and 8,760 dives have been recorded over 11 years. Two fatalities were reported, both in non-insulin dependent divers. One incident of hypoglycaemia underwater in an insulin dependent diabetic diver has been reported. **CONCLUSIONS:** This survey showed that in the group of well-controlled diabetic divers studied, there were no serious problems due to hypoglycaemia when they dived. Long-term complications of diabetes must be excluded before a diabetic diver may be permitted to dive.

PMID: 15796312 [PubMed - indexed for MEDLINE]

33: Undersea Hyperb Med. 2005 Jan-Feb;32(1):11-20.

Neurological manifestations in Japanese Ama divers.

Kohshi K, Wong RM, Abe H, Katoh T, Okudera T, Mano Y.

Department of Neurosurgery, University of Occupational and Environmental Health, Japan, Kitakyushu, Japan.

Repetitive breath-hold (BH) diving can lead to accumulation of nitrogen (N₂) in blood and tissues, which may give rise to decompression illness (DCI). An unusual condition is "Taravana", the diving syndrome reported by Cross in the 1960s. That report generated wide discussion as to whether BH diving can cause DCI. Paulev was the first person to suggest the link between DCI and BH diving. He, a submarine medical officer developed symptoms of DCI after a series of BH dives, having proceeded the dives by spending time in a hyperbaric chamber at 20 meters for 8 minutes. Recently four professional Japanese BH divers (Ama) with histories of diving accidents were reported. Magnetic resonance imaging of these divers detected cerebral infarcts localized in the watershed areas of the brain. A survey conducted on their island revealed that many Ama divers had experienced stroke-like events. A clinical feature of DCI in BH diving is that the damage is limited to the brain. Although the mechanisms of brain damage in BH diving are unclear, N₂ bubbles passing through the lungs or the heart so as to become arterialized are most likely to be the etiological factor.

Publication Types: Review

PMID: 15796310 [PubMed - indexed for MEDLINE]

34: Anat Rec A Discov Mol Cell Evol Biol. 2005 May;284(1):500-10.

Structure and biomechanical properties of the trachea of the striped dolphin *Stenella coeruleoalba*: evidence for evolutionary adaptations to diving.

Cozzi B, Bagnoli P, Acocella F, Costantino ML.

Department of Experimental Veterinary Science, University of Padova, Legnaro, Italy. bruno.cozzi@unipd.it

This study analyzes the structure and mechanical properties of the trachea of the striped dolphin *Stenella coeruleoalba*, one of the most common cetacean species. The cetacean trachea is made up of closed or semiclosed cartilaginous rings without a paries membranaceus. Our results indicate that the inner lining of the trachea contains erectile tissue in which several venous lacunae permeate the mucosa. We also observed and described the presence of peripheral neurons containing nitric oxide along the rim of the venous lacunae. Data obtained from compression and tensile tests and comparison with the pig and goat tracheas indicate a higher stiffness and a different, higher breaking point for the dolphin trachea. On the whole, our data suggest that the trachea of the striped dolphin possesses structural properties that allow rapid filling with blood, possibly in relation to dive activities, and also allow modifications due to increased pressure and immediate return to the original shape without risks of permanent bending or rupture, as would happen in a terrestrial mammal. As the organ undergoes intense pressure difference during descent to optimal foraging depth and subsequent rapid ascent to surface, especially in deep dives of hundreds of meters, the specific structural and biomechanical peculiarities of the trachea of the striped dolphin may represent an evolutionary adaptation to life in the water and to diving. Copyright (c) 2005 Wiley-Liss, Inc.

PMID: 15791584 [PubMed - indexed for MEDLINE]

35: Clin J Sport Med. 2005 Mar;15(2):95-7.

Does competitive apnea diving have a long-term risk? Cardiopulmonary findings in breath-hold divers. Scherhag A, Pflieger S, Grosselfinger R, Borggreffe M.

I. Medical Clinic, University Hospital Mannheim, Faculty of Clinical Medicine, Mannheim University of Heidelberg, Mannheim, Germany. armin.scherhag@roche.com

STUDY PURPOSE: The aim of this study was to investigate the cardiopulmonary status in a competitive apnea diving team. **DESIGN:** This study was conducted with a cross-sectional study design in which subjects had to undergo a predefined series of cardiopulmonary examinations. **SUBJECTS:** Eight competitive apnea divers (mean age, 26.9 +/- 5.3 years) who were participating in international apnea diving contests. **METHODS:** Electrocardiographic, 2-dimensional echocardiographic, Doppler-echocardiographic, and oxymetric examinations were

performed in each subject during an apnea test. RESULTS: Apnea diving experience was 2.5 +/- 0.58 years, with a training frequency of 8.9 +/- 6.0 dives per week. During an apnea test, mean apnea time was 4.5 +/- 0.96 minutes. While 2-dimensional echocardiography showed normal morphologic findings of cardiac dimensions and function, electrocardiography, and Doppler echocardiography revealed indicators suggesting the beginning of right ventricular strain. CONCLUSIONS: We interpret the findings of our study as the onset of pulmonary hypertension resulting from repetitive pulmonary vasoconstriction together with severe hypoxia during apnea diving. We conclude that regular competitive apnea diving over a period of >2 to 3 years might carry a chronic cardiopulmonary risk that may lead from early functional changes to manifestation of pulmonary hypertension. PMID: 15782054 [PubMed - indexed for MEDLINE]

36: Am J Cardiol. 2005 Apr 1;95(7):912-5. Evidence for increasing patency of the foramen ovale in divers. Germonpre P, Hastir F, Dendale P, Marroni A, Nguyen AF, Balestra C. Center for Hyperbaric Oxygen Therapy, Brussels, Belgium. peter.germonpre@mil.be Using a standardized contrast-enhanced transesophageal echocardiographic technique, a group of divers was reexamined for the presence and size of patent foramen ovale (PFO) 7 years after their initial examinations. Unexpected but significant increases in the prevalence and size of PFO were found, suggesting a possible increasing risk for decompression sickness in these divers over time. PMID: 15781033 [PubMed - indexed for MEDLINE]

37: Physiol Biochem Zool. 2005 Mar-Apr;78(2):285-97. Epub 2005 Mar 4. Effects of diving and swimming behavior on body temperatures of pacific leatherback turtles in tropical seas. Southwood AL, Andrews RD, Paladino FV, Jones DR. Department of Zoology, University of British Columbia, Vancouver, Canada. amanda.southwood@noaa.gov Mathematical models and recordings of cloacal temperature suggest that leatherback turtles (*Dermochelys coriacea*) maintain core body temperature higher than ambient water temperature (T(W)) while freely swimming at sea. We investigated the thermoregulatory capabilities of free-ranging leatherbacks and, specifically, the effect that changes in diving patterns and ambient temperatures have on leatherback body temperatures (T(B)). Data loggers were used to record subcarapace and gastrointestinal tract temperatures (T(SC) and T(GT), respectively), T(W), swim speed, dive depth, and dive times of female leatherback turtles during interesting intervals off the coast of Guanacaste, Costa Rica. Mean T(SC) (28.7 degrees -29.0 degrees

C) was significantly higher than mean T(W) (25.0 degrees -27.5 degrees C). There was a significant positive relationship between T(SC) and T(W) and a significant negative correlation between T(SC) and dive depth and T(GT) and dive depth. Rapid fluctuations in T(GT) occurred during the first several days of the interesting interval, which suggests that turtles were ingesting prey or water during this time. Turtles spent 79%-91% of the time at sea swimming at speeds greater than 0.2 m s(-1), and the average swim speed was 0.7 +/- 0.2 m s(-1). Results from this study show that alterations in diving behavior and T(W) affect T(B) of leatherback turtles in the tropics. Body temperatures of free-ranging leatherback turtles correspond well with values for T(B) predicted by mathematical models for tropical conditions. PMID: 15778947 [PubMed - indexed for MEDLINE]

38: Physiol Biochem Zool. 2005 Mar-Apr;78(2):273-84. Epub 2005 Mar 1. Breathing hypoxic gas affects the physiology as well as the diving behaviour of tufted ducks. Halsey LG, Butler PJ, Woakes AJ. School of Biosciences, University of Birmingham, UK.

We measured the effects of exposure to hypoxia (15% and 11% oxygen) and hypercapnia (up to 4.5% carbon dioxide) on rates of respiratory gas exchange both between and during dives in tufted ducks, *Aythya fuligula*, to investigate to what extent these may explain changes in diving behaviour. As found in previous studies, the ducks decreased dive duration (t(d)) and increased surface duration when diving from a hypoxic or hypercapnic gas mix. In the hypercapnic conditions, oxygen consumption during the dive cycle was not affected. Oxygen uptake between dives was reduced by only 17% when breathing a hypoxic gas mix of 11% oxygen. However, estimates of the rate of oxygen metabolism during the foraging periods of dives decreased nearly threefold in 11% oxygen. Given that tufted ducks normally dive well within their aerobic dive limits and that they significantly reduced their t(d) during hypoxia, it is not at all clear why they make this physiological adjustment. PMID: 15778946 [PubMed - indexed for MEDLINE]

39: Eur J Appl Physiol. 2005 Mar;93(5-6):701-7. Epub 2004 Nov 25. Aggravated hypoxia during breath-holds after prolonged exercise. Lindholm P, Gennser M. Section of Environmental Physiology, Department of Physiology and Pharmacology, Karolinska Institutet, Berzelius vag 13, 17177 Stockholm, Sweden. peter.lindholm@fyfa.ki.se Hyperventilation prior to breath-hold diving increases the risk of syncope as a result of hypoxia. Recently, a number of cases of near-drownings in which the swimmers did not hyperventilate before breath-hold diving have come to our attention. These individuals

had engaged in prolonged exercise prior to breath-hold diving and it is known that such exercise enhances lipid metabolism relative to carbohydrate metabolism, resulting in a lower production of CO₂ per amount of O₂ consumed. Therefore, our hypothesis was that an exercise-induced increase in lipid metabolism and the associated reduction in the amount of CO₂ produced would cause the urge to breathe to develop at a lower P O₂, thereby increasing the risk of syncope due to hypoxia. Eight experienced breath-hold divers performed 5 or 6 breath-holds at rest in the supine position and then 5 or 6 additional breath-holds during intermittent light ergometer exercise with simultaneous apnoea (dynamic apnoea, DA) on two different days: control (C) and post prolonged sub-maximal exercise (PPE), when the breath-holds were performed 30 min after 2 h of sub-maximal exercise. After C and before the prolonged submaximal exercise subjects were put on a carbohydrate-free diet for 18 h to start the depletion of glycogen. The respiratory exchange ratio (RER) and end-tidal P CO₂, P O₂, and SaO₂ values were determined and the data were presented as means (SD). The RER prior to breath-holding under control conditions was 0.83 (0.09), whereas the corresponding value after exercise was 0.70 (0.05) (P < 0.01). When the three apnoeas of the longest duration for each subject were analysed, the average duration of the dynamic apnoeas was 96 (14) s under control conditions and 96 (17) s following exercise. Both P O₂ and P CO₂ were higher during the control dynamic apnoeas than after PPE [PO₂ 6.9 (1.0) kPa vs 6.2 (1.2) kPa, P < 0.01; P CO₂ 7.8 (0.5) kPa vs 6.7 (0.4) kPa, P < 0.001; ANOVA testing]. A similar pattern was observed after breath-holding under resting conditions, i.e., a lower end-tidal P O₂ and P CO₂ after exercise (PPE) compared to control conditions. Our findings demonstrate that under the conditions of a relatively low RER following prolonged exercise, breath-holding is terminated at a lower P O₂ and a lower P CO₂ than under normal conditions. This suggests that elevated lipid metabolism may constitute a risk factor in connection with breath-holding during swimming and diving. PMID: 15778900 [PubMed - indexed for MEDLINE]

40: *Int J Sports Med.* 2005 Apr;26(3):177-81.

Arterial oxygen saturation and heart rate variation during breath-holding: comparison between breath-hold divers and controls.

Delahoche J, Delapille P, Lemaitre F, Verin E, Tourny-Chollet C.

Centre d' Etudes des Transformations des Activités Physiques et Sportives (CETAPS), Jeune Equipe UPRES no. 2318, Faculté des Sciences du Sport et de l' Education Physique de Rouen, Université de Rouen, 34 rue de l' Hopital, 76000 Rouen, France.

Breath-holding induces cardiovascular responses, notably bradycardia and peripheral vasoconstriction, which are known collectively as the diving response. This response is oxygen-conserving, i.e. an augmented response attenuates arterial oxygen

desaturation, and is enhanced by apnoea training. To test this hypothesis, we compared heart rate (HR) and arterial oxygen saturation (SaO₂) in breath-hold divers (BHD) and non-divers (ND). Nine BHD and nine healthy ND performed two static apnoeas (for 30 s and 45 s) and two dynamic apnoeas (for 30 s and 45 s) while swimming underwater at 0.7 m . s⁻¹. The pool temperature was 26 degrees C. The apnoeas were performed at 60 % of forced vital capacity. Heart rate (HR) and SaO₂ were recorded before breath-holding and at its end and are expressed in % change from rest values (DeltaHR and DeltaSaO₂). Comparisons between BHD and ND showed that DeltaSaO₂ were lower in divers after both static apnoeas for 30 s and 45 s (- 2.8 % vs. - 5.5 %; - 3.2 % vs. 6.3 %; p < 0.05, respectively) and dynamic apnoeas (- 6 % vs. - 10.1 %; - 7.2 % vs. - 12.3 %; p < 0.05, respectively). The change in HR did not differ between the two groups and negative linear relations were found between DeltaHR and DeltaSaO₂ in both divers and ND (r = 0.66 and 0.61, respectively; p < 0.001). Moreover, the slope was lower for the divers (- 0.785 vs. - 0.1429; p < 0.001). Our results suggest that apnoea training explained the greater oxygen conservation seen in the divers in both static and dynamic conditions.

PMID: 15776332 [PubMed - indexed for MEDLINE]

41: *Ital Heart J.* 2005 Jan;6(1):73-6.

Patent foramen ovale in scuba divers. A report of two cases and a brief review of the literature.

Chessa M, Clai F, Vigna C, Butera G, Negura DG, Giamberti A, Bossone E, Carminati M.

Pediatric Cardiology, Istituto Policlinico San Donato, San Donato Milanese, Italy. massichessa@yahoo.it

Scuba diving (diving with a self-contained underwater breathing apparatus) has become a popular sport. Decompression illness may be due to the formation of gas bubbles in various body tissues at an increased ambient pressure. The gas can pass from the systemic venous circulation into the arterial circulation as a result of either pulmonary barotrauma or intravascular shunting. Gas emboli may be the cause of an increased prevalence of brain lesions in sport divers. The management of scuba divers (professionals and amateurs) with a patent foramen ovale is not clear. We present the cases of 2 subjects with decompression illness and a patent foramen ovale and briefly review the literature on this combination.

Publication Types: Review

PMID: 15773277 [PubMed - indexed for MEDLINE]

42: *Am J Physiol Regul Integr Comp Physiol.* 2005 Aug;289(2):R326-R331. Epub 2005 Mar 10.

Inhibition of shivering in hypothermic seals during diving.

Kvadsheim PH, Folkow LP, Blix AS.

Department of Arctic Biology and Institute of Medical Biology, University of Tromsø, Tromsø, Norway. phk@ffi.no

The mammalian response to hypothermia is increased metabolic heat production, usually by way of muscular activity, such as shivering. Seals, however, have been reported to respond to diving with hypothermia, which in other mammals under other circumstances would have elicited vigorous shivering. In the diving situation, shivering could be counterproductive, because it obviously would increase oxygen consumption and therefore reduce diving capacity. We have measured the electromyographic (EMG) activity of three different muscles and the rectal and brain temperature of hooded seals (*Cystophora cristata*) while they were exposed to low ambient temperatures in a climatic chamber and while they performed a series of experimental dives in cold water. In air, the seals had a normal mammalian shivering response to cold. Muscles were recruited in a sequential manner until body temperature stopped dropping. Shivering was initiated when rectal temperature fell below 35.3 +/- 0.6 degrees C (n = 6). In the hypothermic diving seal, however, the EMG activity in all of the muscles that had been shivering vigorously before submergence was much reduced, or stopped altogether, whereas it increased again upon emergence but was again reduced if diving was repeated. We conclude that shivering is inhibited during diving to allow a decrease in body temperature whereby oxygen consumption is decreased and diving capacity is extended.

PMID: 15761184 [PubMed - indexed for MEDLINE]

43: Hawaii Med J. 2005 Jan;64(1):12-3.

Concomitant cerebral and coronary arterial gas emboli in a sport diver: a case report.

Smerz RW.

University of Hawaii, John A Burns School of Medicine, Honolulu, HI 96817, USA.

This report presents a case of concomitant cerebral and coronary gas emboli seen in a sport scuba diver after suffering from pulmonary barotrauma. Except for massive fatal gas embolism, no case of concomitant cerebral and coronary arterial gas emboli has been reported. The 45 year old male diver rapidly surfaced from a depth of 32 feet of sea water and experienced transient loss of consciousness, chest pain, and hemiparesis. EKG and cardiac enzymes suggested myocardial ischemia. He received three recompression treatments and recovered completely.

Publication Types: Case Reports

PMID: 15751753 [PubMed - indexed for MEDLINE]

44: Aviat Space Environ Med. 2005 Feb;76(2):114-6.
N-terminal pro brain natriuretic peptide increases after 1-h scuba dives at 10 m depth.

Gempp E, Blatteau JE, Louge P, Drouillard I, Galland FM.

Naval Medicine Institute, Toulon, France.
gempp@voila.fr

OBJECTIVES: The N-terminal pro brain natriuretic peptide (N-BNP) is a promising cardiac natriuretic peptide used as a clinical hormonal marker in cardiac

dysfunction. The main stimulus for N-BNP synthesis and secretion is cardiac wall stress, which is recognized as a common denominator of many cardiac diseases. Diving is associated with environmental factors leading to variations in thoracic blood volume and hemodynamic changes. The purpose of the present study was to examine the changes in the concentration of N-BNP in healthy men during and after scuba diving. METHOD: There were 10 healthy military divers (mean age 33 yr) who performed a dive in the sea for 1 h at 10 m depth. Venous blood samples were taken at timed intervals to allow evaluation of plasma levels of N-BNP at different steps, namely at To (before immersion), at T30 min (during the dive, after a short surfacing), at T60 min (right after surfacing), at T300 min (post-dive), and finally at T24 h. Peptide blood concentrations were determined by electrochemoluminescence immunoassay. Data were analyzed using parametric statistics. RESULTS: When compared with To, the results show a significant increase of N-BNP levels (in % of baseline levels) at T60(128 +/- 5%, p < 0.043) and at T300 (149 +/- 8%, p < 0.001). CONCLUSION: This preliminary study reveals that N-BNP rises with scuba diving. Our findings suggest that diving involves a mechanical strain on the heart with a persistent endocrine myocardial activity post-dive.

PMID: 15742826 [PubMed - indexed for MEDLINE]

45: Aviat Space Environ Med. 2005 Feb;76(2):97-102.

Isoproterenol accelerates decompression sickness and death after saturation dives in swine.

Nelson JW, Werner JK, Burge JR.

Naval Medical Research Center, Silver Spring, MD 20910-7500, USA.

BACKGROUND: Disabled submarine (DISSUB) survivors are expected to achieve inert gas tissue saturation that would likely cause severe decompression sickness (DCS). Rescue procedures in a DISSUB scenario cannot accommodate a staged decompression and the availability of recompression treatment chambers is limited. Alternatives to the standard recompression procedures for treating DCS are needed. Experimentally, isoproterenol has successfully addressed many underlying physiological concerns expected to result in cardiopulmonary DCS in this group. HYPOTHESIS: We hypothesized that isoproterenol would reduce the incidence of cardiopulmonary DCS in a saturation dropout model. METHODS: Yorkshire swine (21.8 +/- 1.68 kg) were fitted with an external jugular catheter and compressed to 4.33 ATA in a dry chamber for 22 h. They were infused with isoproterenol (0.002 mg x kg(-1)) while still at depth and returned to the surface without decompression stops. They received additional infusions every 10 min throughout a 2-h observation period. Signs of DCS were recorded to the nearest minute. RESULTS: Isoproterenol administration resulted in a significant increase in the incidence of severe cardiopulmonary

DCS (13/34 control vs. 12/18 isoproterenol) and death from DCS (10/34 control vs. 11/18 isoproterenol). There was no difference in the incidence of severe neurological DCS. CONCLUSIONS: Administering isoproterenol as an intervention/treatment for DCS significantly increases the risk of cardiopulmonary DCS and death following saturation dropout in 20-kg swine. As an adjunctive therapy or alternative to staged decompression, isoproterenol in the dose regimen delivered here is not expected to improve outcome in a DISSUB mass casualty scenario.
PMID: 15742823 [PubMed - indexed for MEDLINE]

46: *Med Clin (Barc)*. 2005 Feb 19;124(6):238; author reply 238-9.
Comment on: *Med Clin (Barc)*. 2004 Sep 4;123(7):277-8.
[Red sea coral sting]
[Article in Spanish]
Lopez Jimenez L.
Publication Types: Comment Letter
PMID: 15737311 [PubMed - indexed for MEDLINE]

47: *Proc Biol Sci*. 2005 Feb 22;272(1561):355-63.
Ascent exhalations of Antarctic fur seals: a behavioural adaptation for breath-hold diving?
Hooker SK, Miller PJ, Johnson MP, Cox OP, Boyd IL.
Sea Mammal Research Unit, University of St Andrews, Fife KY16 8LB, UK. s.hooker@st-andrews.ac.uk
Novel observations collected from video, acoustic and conductivity sensors showed that Antarctic fur seals consistently exhale during the last 50-85% of ascent from all dives (10-160 m, n > 8000 dives from 50 seals). The depth of initial bubble emission was best predicted by maximum dive depth, suggesting an underlying physical mechanism. Bubble sound intensity recorded from one seal followed predictions of a simple model based on venting expanding lung air with decreasing pressure. Comparison of air release between dives, together with lack of variation in intensity of thrusting movement during initial descent regardless of ultimate dive depth, suggested that inhaled diving lung volume was constant for all dives. The thrusting intensity in the final phase of ascent was greater for dives in which ascent exhalation began at a greater depth, suggesting an energetic cost to this behaviour, probably as a result of loss of buoyancy from reduced lung volume. These results suggest that fur seals descend with full lung air stores, and thus face the physiological consequences of pressure at depth. We suggest that these regular and predictable ascent exhalations could function to reduce the potential for a precipitous drop in blood oxygen that would result in shallow-water blackout.
PMID: 15734689 [PubMed - indexed for MEDLINE]

48: *Sports Med*. 2005;35(3):183-90.
Pulmonary oedema of immersion.

Koehle MS, Lepawsky M, McKenzie DC.
Allan McGavin Sports Medicine Centre, University of British Columbia, Vancouver, British Columbia, Canada. mskoehle@interchange.ubc.ca
Acute pulmonary oedema has been described in individuals participating in three aquatic activities: (i) scuba diving; (ii) breath-hold diving; and (iii) endurance swimming. In this review, 60 published cases have been compiled for comparison. Variables considered included: age; past medical history; activity; water depth, type (salt or fresh) and temperature; clinical presentation; investigations; management; and outcome. From these data, we conclude that a similar phenomenon is occurring among scuba, breath-hold divers and swimmers. The pathophysiology is likely a pulmonary overperfusion mechanism. High pulmonary capillary pressures lead to extravasation of fluid into the interstitium. This overperfusion is caused by the increase in ambient pressure, peripheral vasoconstriction from ambient cold, and increased pulmonary blood flow resulting from exercise. Affected individuals are typically healthy males and females. Older individuals may be at higher risk. The most common symptoms are cough and dyspnoea, with haemoptysis also a frequent occurrence. Chest pain has never been reported. Radiography is the investigation of choice, demonstrating typical findings for pulmonary oedema. Management is supportive, with oxygen the mainstay of treatment. Cases usually resolve within 24 hours. In some cases, diuretics have been used, but there are no data as to their efficacy. Nifedipine has been used to prevent recurrence, but there is only anecdotal evidence to support its use.
Publication Types: Review
PMID: 15730335 [PubMed - indexed for MEDLINE]

49: *Mil Med*. 2005 Jan;170(1):57-62.
Comment in: *Mil Med*. 2006 Jan;171(1):ii.
The role of radiology in dive-related disorders.
Carson WK, Mecklenburg B.
Naval Station Ingleside, Fleet Support Activity, 120 Coral Sea Road, Suite 165, Ingleside, TX 78362, USA.
Recreational scuba diving has continued to grow in popularity in the past several decades, and military diving remains an integral part of ship husbandry, explosives and ordinance disposal, and special warfare. Although relatively uncommon, disorders such as decompression sickness and arterial gas embolism can be fatal, whereas disorders such as ear baro-trauma and dysbaric osteonecrosis are not fatal but can cause significant morbidity. An extensive literature search was performed to comprehensively examine the current role of diagnostic radiology with respect to diving medicine. In selected cases, diagnostic imaging can be of potential benefit for evaluation. Diagnostic imaging plays a useful role in the screening of certain individuals for future fitness to dive. Radiological imaging has also been of paramount importance in postmortem evaluation of dive casualties.

Publication Types: Review
PMID: 15724856 [PubMed - indexed for MEDLINE]

50: *Physiol Biochem Zool.* 2005 Jan-Feb;78(1):9-17.
Diving heart rate development in postnatal harbour seals, *Phoca vitulina*.
Greaves DK, Schreer JF, Hammill MO, Burns JM.
Department of Biology, University of Waterloo,
Waterloo, Ontario N2L 3G1, Canada.
dgreaves@healthy.uwaterloo.ca
Harbour seals, *Phoca vitulina*, dive from birth, providing a means of mapping the development of the diving response, and so our objective was to investigate the postpartum development of diving bradycardia. The study was conducted May-July 2000 and 2001 in the St. Lawrence River Estuary (48 degrees 41' N, 68 degrees 01' W). Both depth and heart rate (HR) were remotely recorded during 86,931 dives (ages 2-42 d, n = 15) and only depth for an additional 20,300 dives (combined data covered newborn to 60 d, n = 20). The mean dive depth and mean dive durations were conservative during nursing (2.1 +/- 0.1 m and 0.57 +/- 0.01 min, range = 0-30.9 m and 0-5.9 min, respectively). The HR of neonatal pups during submersion was bimodal, but as days passed, the milder of the two diving HRs disappeared from their diving HR record. By 15 d of age, most of the dive time was spent at the lower diving bradycardia rate. Additionally, this study shows that pups are born with the ability to maintain the lower, more fully developed dive bradycardia during focused diving but do not do so during shorter routine dives.
PMID: 15702458 [PubMed - indexed for MEDLINE]

51: *Physiol Biochem Zool.* 2005 Jan-Feb;78(1):1-8.
Diving behaviour of a reptile (*Crocodylus johnstoni*) in the wild: interactions with heart rate and body temperature.
Seebacher F, Franklin CE, Read M.
School of Biological Sciences A08, University of Sydney, Sydney, New South Wales 2006, Australia.
fseebach@bio.usyd.edu.au
The differences in physical properties of air and water pose unique behavioural and physiological demands on semiaquatic animals. The aim of this study was to describe the diving behaviour of the freshwater crocodile *Crocodylus johnstoni* in the wild and to assess the relationships between diving, body temperature, and heart rate. Time-depth recorders, temperature-sensitive radio transmitters, and heart rate transmitters were deployed on each of six *C. johnstoni* (4.0-26.5 kg), and data were obtained from five animals. Crocodiles showed the greatest diving activity in the morning (0600-1200 hours) and were least active at night, remaining at the water surface. Surprisingly, activity pattern was asynchronous with thermoregulation, and activity was correlated to light rather than to body temperature. Nonetheless, crocodiles thermoregulated and showed a typical heart rate hysteresis pattern (heart rate during heating greater than heart rate during cooling) in response to

heating and cooling. Additionally, dive length decreased with increasing body temperature. Maximum diving length was 119.6 min, but the greatest proportion of diving time was spent on relatively short (<45 min) and shallow (<0.4 m) dives. A bradycardia was observed during diving, although heart rate during submergence was only 12% lower than when animals were at the surface.
PMID: 15702457 [PubMed - indexed for MEDLINE]

52: *Otol Neurotol.* 2005 Jan;26(1):59-64.
Evaluation of predictive parameters related to eustachian tube dysfunction for symptomatic middle ear barotrauma in divers.
Uzun C.
Department of Otolaryngology, Trakya University Faculty of Medicine, Edirne, Turkey.
cemuzun@yahoo.com
OBJECTIVE: Eustachian tube dysfunction plays an important role in the pathogenesis of middle ear barotrauma. This investigation evaluates the predictive value of several parameters related to tubal dysfunction, in relation to symptomatic middle ear barotrauma in divers. STUDY DESIGN: Prospective and blinded. PATIENTS: Thirty-one sport scuba divers with normal predictive audiometry, tympanometry, and general and otorhinolaryngologic examination. METHODS: After an occurrence of middle ear barotrauma, the individual diver predictive data on smoking, mild septal deviation, otitis media history, rhinosinusitis history, Valsalva, Toynbee, and nine-step inflation/deflation tympanometric test, as well as degree of mastoid pneumatization were registered for calculation of predictive value in relation to the barotrauma. All symptomatic ears were examined within 24 hours of diving by the investigator, who was blinded to the predictive findings. Barotraumas that occurred during an upper respiratory tract infection were excluded. RESULTS: Divers completed a total of 774 dives (median, 25; range, 3-100). Symptomatic middle ear barotrauma occurred in 19 ears (31%) of 14 divers (45%) at one time or another. The rate of tubal dysfunction measured by the nine-step test and a mastoid pneumatization below average were significantly higher in divers (p <0.05) as well as in ears (p <0.005) with barotrauma. Positive and negative predictive values of both parameters for subsequent barotrauma were between 69% and 76%. Combining the results into a two-test battery in a strict approach (positive on both) increased the positive predictive value to 86%. CONCLUSION: Eustachian tube dysfunction measured by the nine-step test and a small size of the mastoid cell system seem to be risk factors for symptomatic middle ear barotrauma in otherwise healthy sport scuba divers. Evaluation of these factors in the predictive examination of diving candidates may be useful in the determination of fitness to dive.
PMID: 15699720 [PubMed - indexed for MEDLINE]

53: *Scand J Med Sci Sports.* 2005 Feb;15(1):3-12.

The human diving response, its function, and its control.

Foster GE, Sheel AW.

Health and Integrative Physiology Laboratory, School of Human Kinetics, University of British Columbia, Vancouver, BC, Canada.

The purpose of this review is to outline the physiological responses associated with the diving response, its functional significance, and its cardiorespiratory control. This review is separated into four major sections. Section one outlines the diving response and its physiology. Section two provides support for the hypothesis that the primary role of the diving response is the conservation of oxygen. The third section describes how the diving response is controlled and provides a model that illustrates the cardiorespiratory interaction. Finally, the fourth section illustrates potential adaptations that result after regular exposure to an asphyxic environment. The cardiovascular and endocrine responses associated with the diving response and apnea are bradycardia, vasoconstriction, and an increase in secretion of suprarenal catecholamines. These responses require the integration of both the cardiovascular system and the respiratory system. The primary role of the diving response is likely to conserve oxygen for sensitive brain and heart tissue and to lengthen the time before the onset of serious hypoxic damage. We suggest that future research should be focused towards understanding the role of altered ventilatory responses in human breath-hold athletes as well as in patients suffering from sleep-disordered breathing.

Publication Types: Review

PMID: 15679566 [PubMed - indexed for MEDLINE]

54: *Cardiol Clin*. 2005 Feb;23(1):97-104.

Patent foramen ovale and diving.

Germonpre P.

Centre for Hyperbaric Oxygen Therapy, Military Hospital Brussels, Bruynstraat 200, Brussels 1120, Belgium. peter.germonpre@mil.be

Patency of the foramen ovale is a risk factor for DCS in SCUBA divers, even if they adhere to the currently accepted and used decompression tables. The primary cause of DCS, however, is the nitrogen bubble, not the PFO. There are a number of techniques any diver can use to minimize the occurrence of nitrogen bubbles after a dive. The authors current practice is to inform civilian sports divers of the increased risk and to advise them to adopt conservative dive profiles. This can be achieved by selecting a more conservative dive computer, performing only dives that do not require obligatory decompression stops, or using oxygen-enriched breathing gas mixtures ("nitrox") while still diving on "air profiles" [56]. Dive-safety organizations are currently undertaking studies aimed at proposing changes in the decompression algorithms to produce low-bubble dive tables [12]. In the meantime, PFO remains a reason for caution. Whether all divers should be screened for PFO is an ongoing discussion [50] in

view of methodologic and practical issues outlined in this article. Any definitive recommendations can be made only after a careful, prospective evaluation of the real relative risk for DCS and long-term cerebral damage.

Publication Types: Review

PMID: 15676273 [PubMed - indexed for MEDLINE]

55: *J Appl Physiol*. 2005 May;98(5):1653-9. Epub 2004 Dec 17.

Response to CO₂ in novice closed-circuit apparatus divers and after 1 year of active oxygen diving at shallow depths.

Eynan M, Arieli R, Adir Y.

Israel Naval Medical Institute, POB 8040, Haifa 31080, Israel. emirit@netvision.net.il

Elevated arterial Pco₂ (hypercapnia) has a major effect on central nervous system oxygen toxicity in diving with a closed-circuit breathing apparatus. The purpose of the present study was to follow up the ability of divers to detect CO₂ and to determine the CO₂ retention trait after 1 year of active oxygen diving with closed-circuit apparatus. Ventilatory and perceptual responses to variations in inspired CO₂ (range: 0-5.6 kPa, 0-42 Torr) during moderate exercise were assessed in Israeli Navy combat divers on active duty. Tests were carried out on 40 divers during the novice oxygen diving phase (ND) and the experienced oxygen diving phase. No significant changes were found between the two phases for the minimal mean inspired Pco₂ that could be detected. The mean (with SD in parentheses) end-tidal Pco₂ during exposure to an inspired Pco₂ of 5.6 kPa (42 Torr) was significantly higher in the novice diving phase than in the experienced diving phase [8.1 kPa (SD 0.7), 62 Torr (SD 5) and 7.8 kPa (SD 0.6), 59 Torr (SD 4), respectively; P < or = 0.001]. One year of shallow oxygen diving activity with a closed-circuit apparatus does not affect the ability to detect CO₂ nor does it lead to increased CO₂ retention; rather, it may even bring about a decrease in this trait. This finding suggests that acquiring experience in oxygen diving with a closed-circuit apparatus at shallow depths does not place the diver at a greater risk of central nervous system oxygen toxicity due to CO₂ retention.

PMID: 15608093 [PubMed - indexed for MEDLINE]

56: *Clin Sci (Lond)*. 2005 Apr;108(4):365-7.

Comment on: *Clin Sci (Lond)*. 2001 Feb;100(2):215-20.

Re-evaluation of the relationship between migraine and persistent foramen ovale and other right-to-left shunts.

Wilmshurst P, Pearson M, Nightingale S.

Publication Types: Comment Letter

PMID: 15574125 [PubMed - indexed for MEDLINE]

57: *Spinal Cord*. 2005 Feb;43(2):109-16.

Spinal cord injuries due to diving accidents.

Aito S, D' Andrea M, Werhagen L.

Spinal Unit, Careggi Hospital, Firenze, Italy.

STUDY DESIGN: Retrospective study and data analysis. **OBJECTIVE:** To investigate and analyse the main features of spinal cord injuries due to diving accidents accepted in our Centre from June 1978 to December 2002. **SETTING:** Regional Spinal Unit of Florence, Italy. **INTRODUCTION:** Diving accidents mostly occur in a young and healthy population and most of the patients develop tetraplegia with a severe lifelong disability. From 1978 to 2002, 65 patients with spinal injuries due to diving accidents were admitted to the Regional Spinal Unit of Florence. **MATERIAL AND METHODS:** A retrospective study was conducted by analysing data stored in our local computerized database. We considered the vertebral injury, ASIA-ISCOS neurological classification on admission and discharge, gender, age at the time of injury, month of injury, treatment of vertebral lesion, length of stay in the Spinal Unit, neurological outcome, and complications. Data were analysed statistically by using the Fisher's exact test and logistic regression. **RESULTS:** In all, 62/65 patients were males (95%). Mean age at injury time: 22 years. On admission, 35/65 were neurologically complete ASIA A (54%), while 16 were classified ASIA B, 7 ASIA C and 7 ASIA D, according to the ASIA-ISCOS neurological standard of classification. C6 was the most common neurological motor level (40%) and C5 the most common vertebral injury level. In all, 36/65 (55%) patients underwent surgical treatment. Mean hospitalization time was 5 months. No neurological deterioration was recorded. In all, 20/65 (31%) patients improved neurologically and 16/20 (80%) of those had received surgical treatment. In all, 15/65 (23%) patients had complications and one patient died during the hospitalization period. **CONCLUSIONS AND DISCUSSION:** Patients whose vertebral lesions were surgically treated had a better neurological outcome than conservatively treated ones. Teardrop fractures showed worse neurological outcome as compared with burst fractures. Neurological improvement was more present in initially incomplete lesions. Treatment with high dose methylprednisolone during the first 8 h after trauma seemed to influence the neurological outcome positively. Age was also an important factor in influencing the neurological outcome. PMID: 15558081 [PubMed - indexed for MEDLINE]

58: Eur J Appl Physiol. 2005 Jan;93(4):447-52. Epub 2004 Oct 21.

Speed of spleen volume changes evoked by serial apneas.

Schagatay E, Haughey H, Reimers J.

Department of Natural and Environmental Sciences, Mid Sweden University, 851 70 Sundsvall, Sweden. erika.schagatay@mh.se

Diving mammals may enhance dive duration by injecting extra erythrocytes into the circulation by spleen contraction. This mechanism may also be important for apneic duration in humans. We studied the speed and magnitude of spleen volume changes evoked by serial apneas, and the associated changes

in hematocrit (Hct) and hemoglobin (Hb) concentration, diving response and apneic duration. Three maximal apneas separated by 2 min rest elicited spleen contraction in all ten subjects, by a mean of 49 (27) ml (18%; $P < 0.001$). During the same period, Hct and Hb rose by 2.2 and 2.4% respectively ($P < 0.01$ and $P < 0.001$), and apneic duration rose by 20 s (22% $P < 0.05$). The mean heart rate reduction of the diving response was 15%, which remained the same throughout the apnea series. While the diving response was completely reversed between the apneas, spleen size was not recovered until 8-9 min after the final apnea corresponding with recovery of Hct and Hb. Thus, although the spleen contraction may be associated with the cardiovascular diving response, it is likely to be triggered by different mechanisms, and it may remain activated between dives spaced by short pauses. The two adjustments may provide a fast, quickly reversed, and a slow, but long-lasting, way of shifting to a diving mode in humans.

Publication Types: Clinical Trial Controlled Clinical Trial

PMID: 15503125 [PubMed - indexed for MEDLINE]

59: Eur Radiol. 2005 Feb;15(2):368-75. Epub 2004 Oct 15.

Detection of dysbaric osteonecrosis in military divers using magnetic resonance imaging.

Bolte H, Koch A, Tetzlaff K, Bettinghausen E, Heller M, Reuter M.

Klinik fuer Diagnostische Radiologie, Universitaetsklinikum Schleswig-Holstein Campus Kiel, Arnold-Heller-Strasse 9, 24105, Kiel, Germany. hendrikbolte@rad.uni-kiel.de

This was a controlled cross-sectional study to investigate the prevalence of dysbaric osteonecrosis (DON) in military divers. MRI examinations of the large joints and adjacent bones were performed in a cross-sectional group of 32 highly experienced military divers and 28 non-divers matched for age and anthropometric data. Additional plain radiographs and follow-up controls were performed in all persons with signs certain or suspicious of DON. In two subject groups (one of divers and one of non-divers), lesions characteristic of DON were detected. From this controlled study, it may be concluded that MRI is a highly sensitive method to detect signs of osteonecrosis. It could be shown that the prevalence of bone lesions characteristic of osteonecrosis in highly experienced military divers is not higher than in non-diving subjects of comparable age. The outcome of this comparably small study group fits to the results of previous extensive studies performed with radiographs. The detected low incidence of DON in this collective may be due to the fact that military divers follow stricter selection criteria, decompression schemes and medical surveillance than commercial divers.

PMID: 15490180 [PubMed - indexed for MEDLINE]