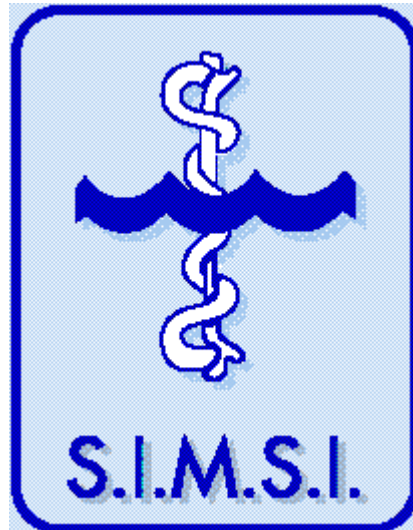
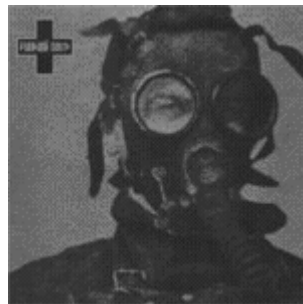


**SOCIETA' ITALIANA  
DI  
MEDICINA SUBACQUEA E IPERBARICA**



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



**2008  
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 2008/01 to 2008/06

**Search "Diving"[MAJR] Limits:  
Publication Date from 2008/01 to  
2008/06**

1: Int Marit Health. 2008;59(1-4):69-80.

Recompression treatment for decompression illness: 5-year report (2003-2007) from National Centre for Hyperbaric Medicine in Poland.

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A serious diving accident can occur in recreational diving even in countries where diving is not very popular due to the fact that diving conditions there are not as great as in some tropical diving locations. The estimated number of injured divers who need recompression treatment in European hyperbaric facilities varies between 10 and 100 per year depending on the number of divers in the population, number of dives performed annually, and number of hyperbaric centres in the country. In 5 years of retrospective observation in Poland (2003-2007) there were 51 cases of injured recreational divers recorded. They either dived locally or after returning home by air from a tropical diving resort. All of them were treated with recompression treatment in the National Centre for Hyperbaric Medicine in Gdynia which has capability to treat any patient with decompression illness using all currently available recompression schedules with any breathing mixtures including oxygen, nitrox, heliox or trimix. The time interval between surfacing and first occurrence of symptoms was significantly lower in the group of patients with neurological decompression sickness or arterial gas embolism (median 0.2 hours) than in the group of patients with other types of decompression sickness (median 2.0 hours). In both groups, there were different types of

recompression tables used for initial treatment and different number of additional sessions of hyperbaric oxygenation (HBO) prescribed, but the final outcome was similar. Complete resolution of symptoms after initial recompression treatment was observed in 24 cases, and this number was increased to 37 cases after additional HBO sessions (from 1 to 20). In the final outcome, some residual symptoms were observed in 12 cases. In 2 cases initial diagnosis of decompression sickness type I was rejected after initial recompression treatment and careful re-evaluation of diving profiles, risk factors and reported symptoms.

PMID: 19227740

2: J Physiol Biochem. 2008 Jun;64(2):135-41.

Effects of hyperoxia on biomarkers of oxidative stress in closed-circuit oxygen military divers.

Alcaraz-García MJ, Albaladejo MD, Acevedo C, Olea A, Zamora S, Martínez P, Parra S.

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Oxygen toxicity is a problem in diving which can have fatal consequences in the water. When divers use closed-circuit oxygen rebreathing apparatus they are taking only oxygen 100% and this hyperoxic exposure increases the generation of reactive oxygen species (ROS) in biological tissues. The objective of the present study is to evaluate the effects of hyperoxia on biomarkers of oxidative stress in closed-circuit oxygen military divers. Fifteen professional divers of Spanish Navy Diving Centre participated in a training program which consisted of one-hour immersion at seven metres of depth breathing oxygen 100% with closed-circuit oxygen rebreathing apparatus. The training went on two or three times per week for the first six weeks and once a week for the last six weeks. Serum total antioxidant status (TAS), levels of glutathione peroxidase (GPx),

nitrites (NO<sub>2</sub>(-)) and urinary concentrations of 15-isoprostane F<sub>2t</sub> were measured. The results show that TAS decreased significantly after 6 weeks (mean 1.38 versus 1.23 mmol/l), with a slight increase at the end (mean 1.31 mmol/l). GPx and F<sub>2</sub>-isoprostanes were significantly lower after 6 and 12 weeks and NO<sub>3</sub>(-) was significantly lower after 6 weeks and remained unchanged until the end. In summary, professional divers who use closed-circuit apparatus and therefore breathe oxygen 100%, do not suffer an important oxidative hyperoxia-induced stress, probably due an adaptive process after hyperoxia. The age and good physical form of the subjects studied could probably enhance the adaptive process to hyperoxia.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 19043983

3: West Afr J Med. 2008 Apr;27(2):87-91.

Characteristics of back pain among commercial drivers and motorcyclists in Lagos, Nigeria.

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**BACKGROUND:** Studies have shown that there is a relationship between back pain and long hours of driving among commercial motor drivers (CMDs). It has also been reported that a high number of CMDs suffer from low back pain (LBP) with loss of working hours. However, little is known about the prevalence of back pain among the motorcyclists particularly the commercial motorcyclists (CMCs). **OBJECTIVE:** To determine and compare the prevalence of back pain among CMDs and CMCs in Lagos state. **METHODS:** A structured questionnaire was administered to 400 each of CMDs and CMCs. The questionnaire contained four sections of 30 items. The respondents were requested to provide information on age, sex, working hour/day, associated back pain and location, pain severity and knowledge of preventive measures. Five hundred and ninety nine returned copies of the questionnaire were analyzed using descriptive statistics. **RESULTS:** The prevalence

of back pain was 193 (64.5%) and 180 (60%) among the CMDs and CMCs respectively. One hundred and seventy eight (59.3%) and 129 (43%) of those who reported back pain among the CMDs and CMCs, complained of LBP. The occurrence of upper back/neck pain was higher in the CMCs {41 (13.7%)} than the CMDs {5 (1.7%)}. Very few respondents {21 (7%) CMDs, and 4 (1.3%) CMCs} were aware of backpain preventive measures and none of the CMCs had formal ergonomics instructions at workplace. **CONCLUSION:** Back pain was a common phenomenon among CMDs and CMCs; while LBP was more prevalent among CMDs, upper back/neck pain was more prevalent among CMCs. Practically, the result of this study can help in preventing occupational injury associated with driving/riding with emphases on good sitting posture.

Publication Types: Comparative Study  
PMID: 19025021

4: Med J Malaysia. 2008 Jun;63(2):166-9.

Decompression illness secondary to occupational diving: recommended management based current legislation and practice in Malaysia.

Rozali A, Khairuddin H, Sherina MS, Zin BM, Sulaiman A. Malaysian Armed Forces Health Services Division.

Occupational divers are exposed to hazards which contribute to the risk of developing decompression illnesses (DCI). DCI consists of Type I decompression sickness (DCS), Type II DCS and arterial gas embolism (AGE), developed from formation of bubbles in the tissues or circulation as a result of inadequate elimination of inert gas (nitrogen) after a dive. In Malaysia, DCI is one of the significant contributions to mortality and permanent residual morbidity in diving accidents. This is a case of a diver who suffered from Type II DCS with neurological complications due to an occupational diving activity. This article mentions the clinical management of the case and makes several recommendations based on current legislations and practise implemented in Malaysia in order to educate medical and health

practitioners on the current management of DCI from the occupational perspective. By following these recommendations, hopefully diving accidents mainly DCI and its sequelae among occupational divers can be minimized and prevented, while divers who become injured receive the proper compensation for their disabilities. Publication Types: Case Reports PMID: 18942312

5: Med J Malaysia. 2008 Jun;63(2):91-5.

Diving accidents treated at a military hospital-based recompression chamber facility in Peninsular Malaysia.

Rozali A, Khairuddin H, Sherina MS, Halim MA, Zin BM, Sulaiman A. Malaysian Armed Forces Health Services Division. rozaliahad@yahoo.com

This paper describes the pattern of diving accidents treated in a military hospital-based recompression chamber facility in Peninsular Malaysia. A retrospective study was carried out to utilize secondary data from the respective hospital medical records from 1st January 1996 to 31st December 2004. A total of 179 cases categorized as diving accidents received treatment with an average of 20 cases per year. Out of 179 cases, 96.3% (n = 173) received recompression treatment. Majority were males (93.3%), civilians (87.2%) and non-Malaysian citizens (59.2%). Commercial diving activities contributed the highest percentage of diving accidents (48.0%), followed by recreational (39.2%) and military (12.8%). Diving accidents due to commercial diving (n = 86) were mainly contributed by underwater logging activities (87.2%). The most common cases sustained were decompression illness (DCI) (96.1%). Underwater logging and recreational diving activities which contribute to a significant number of diving accidents must be closely monitored. Notification, centralised data registration, medical surveillance as well as legislations related to diving activities in Malaysia are essential to ensure adequate monitoring of diving accidents in the future. PMID: 18942290

6: Work. 2008;30(4):423-31.

Physical training of combat diving candidates: implications for the prevention of musculoskeletal injuries.

Pelham TW, Holt LE, White H. Dartmouth, Nova Scotia, Canada.

Physical training (PT) is a significant component in the operational preparation for Canadian Forces (CF) combat divers. However, in developing the various components of a PT program, consideration must be given to the potential for increasing the risk of injury. Indeed, all PT programs should incorporate components that minimize risks of injury, thereby attempting to prevent injury. This report identifies high-risk activities associated with PT during a CF Combat Diving Course and contains recommendations for PT modifications. Major high-risk activities identified were: inappropriate exercises, errors in exercise prescription, particularly in intensity and duration and incorrect lifting methods. From a specificity of training perspective, there is little support for the incorporation of 'dry land flutter kick' (i.e., repetitive, unsupported alternating straight leg raises), or high repetitions of push-ups, sit-ups and chin-ups in the training of CF combat diving candidates. Excessive use of these exercises, as performed during training, pose a high-risk for injury and are not recommended. PMID: 18725705

7: J Sport Exerc Psychol. 2008 Jun;30(3):401-11.

Erratum in: J Sport Exerc Psychol. 2009 Feb;31(1):128-9.

Path analysis of self-efficacy and diving performance revisited.

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The Feltz (1982) path analysis of the relationship between diving efficacy and performance showed that, over trials, past performance was a stronger predictor than self-efficacy of performance. Bandura (1997) criticized the study as statistically "overcontrolling" for past performance by using raw past

performance scores along with self-efficacy as predictors of performance. He suggests residualizing past performance by regressing the raw scores on self-efficacy and entering them into the model to remove prior contributions of self-efficacy imbedded in past performance scores. To resolve this controversy, we reanalyzed the Feltz data using three statistical models: raw past performance, residual past performance, and a method that residualizes past performance and self-efficacy. Results revealed that self-efficacy was a stronger predictor of performance in both residualized models than in the raw past performance model. Furthermore, the influence of past performance on future performance was weaker when the residualized methods were conducted.

PMID: 18648112

8: Undersea Hyperb Med. 2008 May-Jun;35(3):213-8.

The effect of over- or underfilling the soda lime canister on CO<sub>2</sub> absorption in two closed-circuit oxygen rebreathers.

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O<sub>2</sub> diving incidents investigated by our laboratory were related to improper filling of the soda lime canister in closed-circuit oxygen rebreathers. We studied the effect of overfilling or underfilling the canister on CO<sub>2</sub> absorption using a continuous flow of 5% CO<sub>2</sub>. With a full canister in the OxyNG 57, CO<sub>2</sub> began to rise at 130-160 min, reaching 1% at 240 min and 1.5% at 270 min. Similar results were obtained after a reduction of 100 g in the quantity of soda lime packed into the canister. After reductions of 200, 300 and 400 g, the rise in CO<sub>2</sub> concentration occurred earlier as a function of the amount of the reduction. The level of CO<sub>2</sub> in the OxyNG 2 began to rise after 250 min with a full canister, reaching 1% at 340 min and 1.5% at 370 min. After a reduction of 100 g there was a delay in the rise of CO<sub>2</sub>, which reached 1.5% at 390 min. However, when the reduction was 200, 300 and 400 g, the rise in CO<sub>2</sub> concentration tended to occur earlier as a

function of the amount of the reduction. For both rebreathers, when the quantity of soda lime was reduced by 200 g or more, there was a considerable difference in timing between the two test measurements for each weight reduction, due to variations in channeling. For an excess of soda lime, moderate pressure was applied manually to achieve a full canister plus 300 g in the OxyNG 2. The initial rise in CO<sub>2</sub> concentration started early, at 60 min with a full canister plus 300 g compared to 150 min with a full canister; 1% CO<sub>2</sub> was reached at 120 min, compared to 210 min with a full canister. As the use of rebreathers becomes increasingly widespread in diving, close attention should be paid to proper filling of the soda lime canister.

PMID: 18619117

9: Undersea Hyperb Med. 2008 May-Jun;35(3):207-11.

Underutilization of echocardiography for patent foramen ovale in divers with serious decompression sickness. Harrah JD, O'Boyle PS, Piantadosi CA.

Center for Hyperbaric Medicine and Environmental Physiology, Department of Anesthesiology, Duke University Medical Center, Durham, NC, USA.

The presence of a patent foramen ovale (PFO) in compressed gas diving has been considered a risk factor for serious decompression illness (DCS) for more than 20 years. We conducted a ten year retrospective chart review aimed at determining if physicians treating DCS in a university medical center setting used echocardiography to assess PFO in patients with severe DCS, and if so whether PFO is over-represented in that population. Over the ten-year period, 113 divers underwent recompression therapy for decompression sickness. Of these patients, 48 had serious DCS defined by at least one objective neurological finding. We reviewed medical records for the presence of agitated saline contrast echocardiogram testing and whether or not PFO was present. Only 12 of 48 patients with serious DCS underwent transthoracic agitated saline contrast echocardiogram testing. Of these 12 patients, 6 (50%) had a resting PFO. Binomial

proportion testing yielded 95% confidence limits of 21% and 79%. Given 27% PFO prevalence in the general population, PFO may be over-represented in our group of most seriously injured DCS patients yet 75% of patients with objective neurological signs did not undergo echocardiography.  
PMID: 18619116

10: Undersea Hyperb Med. 2008 May-Jun;35(3):185-96.  
Respiratory muscle training improves swimming endurance at depth.  
Ray AD, Pendergast DR, Lundgren CE. Center for Research and Education in Special Environments, School of Medicine and Biomedical Sciences, State University of New York at Buffalo, Buffalo New York, USA.  
Respiratory muscle training (RMT) has been shown to improve divers swimming endurance at 4 feet of depth; however, its effectiveness at greater depths, where gas density and the work of breathing are substantially elevated has not been studied. The purpose of this study was to examine the effects of resistance respiratory muscle training (RRMT) on respiratory function and swimming endurance at 55 feet of depth (270.5 kPa). Nine male subjects (25.9 +/- 6.8 years) performed RRMT for 30 min/day, 5 d/wk, for 4 wks. Pre- and Post RRMT, subjects swam against a pre-determined load (70% VO<sub>2</sub> max) until exhausted. As indices of respiratory muscle strength, maximal inspiratory and expiratory pressures were measured before and immediately following the swims pre- and post-RRMT. These measurements showed that ventilation was significantly lower during the swims and, at comparable swim duration, that the respiratory muscles were considerably less fatigued following RRMT. The reduced ventilation was due to a lower breathing frequency following RRMT. The ventilatory changes following RRMT coincided with significantly increased swimming time to exhaustion (approximately 60%, 31.3 +/- 11.6 vs. 49.9 +/- 16.0 min, pre-vs. post-RRMT, p < 0.05). These results suggest respiratory muscle fatigue limits swimming endurance at depth as well as at the surface and RRMT improves performance.

Publication Types: Research Support, Non-U.S. Gov't Research Support, U.S. Gov't, Non-P.H.S.  
PMID: 18619114

11: Undersea Hyperb Med. 2008 May-Jun;35(3):169-74.  
Conjunctivitis outbreak among divers.  
Olsson DJ, Grant WD, Glick JM. Department of Emergency Medicine, State University of New York, Upstate Medical University, 750 E. Adams Street, Syracuse, NY 13210, USA.

In March 2006, an outbreak of conjunctivitis that occurred over a six day period among twenty-nine individuals who partook in recreational scuba diving trips on two boats off Vitu Levu Island, Fiji. We investigated the likelihood that a communal container used to store diving masks facilitated the spread of conjunctivitis among individuals. The diagnosis of conjunctivitis was based on clinical assessment by a physician. Transmission of conjunctivitis from person to person was documented with eventual identification of the index case, the dive master, a Fijian resident. Topical antibiotics were dispensed accordingly and detergent and bleach were used as mask cleaning agents in an effort to control the outbreak. Follow up surveys were mailed to all twenty-nine participants. Ultimately, fourteen cases of conjunctivitis were documented (46.7%). Eleven cases were verified during the six days in Fiji, two upon arrival back in the U.S., and one case of familial transmission in the U.S. All but two cases resolved within one week. Unknown to these divers was a coincidental, generalized outbreak of acute haemorrhagic conjunctivitis among the Fijian Residents. The communal container used to store diving masks was the likely vector for the spread of infectious conjunctivitis, the first such documented outbreak involving communal diving equipment.  
PMID: 18619112

12: Undersea Hyperb Med. 2008 May-Jun;35(3):163-7.  
Barotraumatic orbital emphysema of rhinogenic origin in a breath-hold diver: a case report.

Bolognini A, Delehay E, Cau M, Cosso L.

Sardinian Institute of Hyperbaric and Subaquatic Medicine, Sassari, Italy.

Orbital emphysema is a well-recognized complication of fractures involving the orbit. Commonly, it occurs when high pressure develops in nasal cavity as during nose blowing, coughing or Valsalva's maneuver and usually occurs in the subcutaneous tissues. We report the case of a young breath-hold diver who developed spontaneous, non compressive orbital emphysema during underwater fishing, with a maximal depth of 25-30 meters in the Sardinian sea. He was otherwise healthy, without previous cranio-facial trauma and nasosinusal diseases or surgery were not present in the history. When he was referred to our attention the patient presented right eyelid ptosis but diplopia and vision impairment were absent. Computer tomography scans showed subcutaneous air in the right upper eyelid and around the eyeball, particularly near the orbit's roof but optic nerve area, intraconal, was free of air. A dehiscence in lamina papyracea was evident. In our opinion, this has been the point of air entry into the orbit. A supportive therapy was advised and two weeks later the emphysema was recovered completely and the subject was symptoms free. The literature has been revised and to our knowledge no previous cases of barotraumatic orbital emphysema, in a breath-hold diver, are referred.

Publication Types: Case Reports  
PMID: 18619111

13: Aviat Space Environ Med. 2008 Jun;79(6):626-8.

High-grade bubbles in left and right heart in an asymptomatic diver at rest after surfacing.

Bakovic D, Glavas D, Palada I, Breskovic T, Fabijanic D, Obad A, Valic Z, Brubakk AO, Dujic Z.

Department of Physiology, University of Split School of Medicine, Split, Croatia.

INTRODUCTION: Most decompression procedures induce the formation of asymptomatic venous gas bubbles. They can be classified as "silent bubbles," which are asymptomatic compared to paradoxical

arterialization of venous gas emboli, which can lead to serious neurologic damage. The penetration of such gas bubbles into the arterial circulation is due to pulmonary barotrauma, intrapulmonary (I-P) passage after massive bubble formation ("chokes"), or intracardiac shunting. Venous gas bubbles can be monitored and graded with echocardiographic scanning. CASE: We believe this is the first case to be reported of a recreational diver who, after surfacing from a dive, developed grade 5 ("white-out") venous gas bubbles in the right heart with evidence of I-P shunt at rest without any symptoms of decompression sickness. Grade 4 gas bubbles were found on the left side of the heart, indicating significant I-P shunting even at rest. CONCLUSION: We observed venous bubbles crossing through the I-P shunt during post-dive recovery at rest in a diver who developed "white out" of venous bubbles. Previously, the maximum bubble grade 5 had been observed in experimental animals, but not in humans. Moreover, a significant bubble grade was found on the left side of the heart, indicating a need for further studies to investigate the mechanisms of post-dive changes in peripheral and central circulation. Publication Types: Case Reports  
Research Support, Non-U.S. Gov't  
PMID: 18581949

14: J Comp Physiol B. 2008 Aug;178(6):745-54. Epub 2008 Jun 25. Pedestrian locomotion energetics and gait characteristics of a diving bird, the great cormorant, *Phalacrocorax carbo*.

White CR, Martin GR, Butler PJ.

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Great cormorants *Phalacrocorax carbo* are foot propelled diving birds that seem poorly suited to locomotion on land. They have relatively short legs, which are presumably adapted for the generation of high forces during the power stroke of aquatic locomotion, and walk with a pronounced "clumsy waddle". We hypothesise (1) that the speed, independent minimum cost of

locomotion ( $C_{min}$ , ml O<sub>2</sub> m<sup>-1</sup>) will be high for cormorants during treadmill exercise, and (2) that cormorants will have a relatively limited speed range in comparison to more cursorial birds. We measured the rate of oxygen consumption ( $V_{O2}$ ) of cormorants during pedestrian locomotion on a treadmill, and filmed them to determine duty factor (the fraction of stride period that the foot is in contact with the ground), foot contact time ( $t_c$ ), stride frequency ( $f$ ), swing phase duration and stride length.  $C_{min}$  was 2.1-fold higher than that predicted by their body mass and phylogenetic position, but was not significantly different from the  $C_{min}$  of runners (Galliformes and Struthioniformes). The extrapolated gamma-intercept of the relationship between  $V_{O2}$  and speed was 1.9-fold higher than that predicted by allometry. Again, cormorants were not significantly different from runners. Contrary to our hypothesis, we therefore conclude that cormorants do not have high pedestrian transport costs. Cormorants were observed to use a grounded gait with two double support phases at all speeds measured, and showed an apparent gait transition between 0.17 and 0.25 m s<sup>-1</sup>. This transition occurs at a Froude number between 0.016 and 0.037, which is lower than the value of approximately 0.5 observed for many other species. However, despite the use of a limited speed range, and a gait transition at relatively low speed, we conclude that the pedestrian locomotion of these foot propelled diving birds is otherwise generally similar to that of cursorial birds at comparable relative velocities.

Publication Types: Comparative Study  
Research Support, Non-U.S. Gov't  
PMID: 18575869

15: Exp Biol Med (Maywood). 2008 Sep;233(9):1181-8. Epub 2008 Jun 5. Expression of endothelial selectin ligands on human leukocytes following dive. Glavas D, Markotic A, Valic Z, Kovacic N, Palada I, Martinic R, Breskovic T, Bakovic D, Brubakk AO, Dujic Z.

Department of Cardiology, University of Split School of Medicine, Soltanska 2, 21000 Split, Croatia. The fact that impaired endothelial-dependent vasodilatation after scuba diving often occurs without visible changes in the endothelial layer implies its biochemical origin. Since Lewisx(CD15) and sialyl-Lewisx(CD15s) are granulocyte and monocyte carbohydrate antigens recognized as ligands by endothelial selectins, we assumed that they could be sensitive markers for impaired vasodilatation following diving. Using flow cytometry, we determined the CD15 and CD15s peripheral blood mononuclear cells of eight divers, 30 mins before and 50 mins after a single dive to 54 m for 20 mins bottom time. The number of gas bubbles in the right heart was monitored by ultrasound. Gas bubbles were seen in all eight divers, with the average number of bubbles/cm<sup>2</sup> 1.9+/-1.9. The proportion of CD15+monocytes increased 2-fold after the dive as well as the subpopulation of monocytes highly expressing CD15s. The absolute number of monocytes was slightly, but not significantly, increased after the dive, whereas the absolute number of granulocytes was markedly elevated (up to 61%). There were no significant correlations between bubble formation and CD15+monocyte expression ( $r=-0.56$ ;  $P=0.17$ ), as well as with monocytes highly expressing CD15s ( $r=0.43$ ;  $P=0.29$ ). This study suggests that biochemical changes induced by scuba diving primarily activate existing monocytes rather than increase the number of monocytes at a time of acute arterial endothelial dysfunction.

Publication Types: Clinical Trial  
Research Support, Non-U.S. Gov't  
PMID: 18535169

16: Respir Physiol Neurobiol. 2008 Jun 30;162(1):85-92. Epub 2008 Apr 22. Breathing pattern, CO<sub>2</sub> elimination and the absence of exhaled NO in freely diving Weddell seals. Falke KJ, Busch T, Hoffmann O, Liggins GC, Liggins J, Mohnhaupt R, Roberts JD Jr, Stanek K, Zapol WM.

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Weddell seals undergo lung collapse during dives below 50 m depth. In order to explore the physiological mechanisms contributing to restoring lung volume and gas exchange after surfacing, we studied ventilatory parameters in three Weddell seals between dives from an isolated ice hole on McMurdo Sound, Antarctica.

**METHODS:** Lung volumes and CO(2) elimination were investigated using a pneumotachograph, infrared gas analysis, and nitrogen washout. Thoracic circumference was determined with a strain gauge. Exhaled nitric oxide was measured using chemiluminescence.

**RESULTS:** Breathing of Weddell seals was characterized by an apneustic pattern with end-inspiratory pauses with functional residual capacity at the end of inspiration. Respiratory flow rate and tidal volume peaked within the first 3 min after surfacing. Lung volume reductions before and increases after diving were approximately 20% of the lung volume at rest. Thoracic circumference changed by less than 2% during diving. The excess CO(2) eliminated after dives correlated closely with the duration of the preceding dive. Nitric oxide was not present in the expired gas.

**CONCLUSION:** Our data suggest that most of the changes in lung volume during diving result from compression and decompression of the gas remaining in the respiratory tract. Cranial shifts of the diaphragm and translocation of blood into the thorax rather than a reduction of thoracic circumference appear to compensate for lung collapse. The time to normalise gas exchange after surfacing was mainly determined by the accumulation of CO(2) during the dive. These findings underline the remarkable adaptations of the Weddell seal for restoring lung volume and gas exchange after diving.

Publication Types: Research Support, Non-U.S. Gov't  
Research Support, U.S. Gov't, Non-P.H.S.  
PMID: 18534926

17: World J Gastroenterol. 2008 May 28;14(20):3262-5.

Acute ischemic colitis during scuba diving: report of a unique case. Goumas K, Poulou A, Tyrmpas I, Dandakis D, Bartzokis S, Tsamouri M, Barbati K, Soutos D. Department of Gastroenterology, Red Cross Hospital of Athens, Athens, Greece.

The presentation of clinical symptoms due to decompression during diving, varies significantly, as mainly minor disturbances for the gastrointestinal tract in particular have been reported. The following case debates whether diving can cause severe symptoms from the gastrointestinal system. We describe a clinical case of ischemic colitis presented in a 27-year-old male, who manifested abdominal pain while in the process of scuba diving 20 meters undersea, followed by bloody diarrhoea as soon as he ascended to sea level. Taking into account his past medical history, the thorough, impeccable clinical and laboratory examinations and presence of no other factors predisposing to ischemia of the colon, we assume that a possible relationship between diving conditions and the pathogenesis of ischemic colitis may exist. This unusual case might represent a hematologic manifestation of decompression sickness, due to increased coagulability and/or transient air emboli, occurring during a routine scuba diving ascent to sea level.

Publication Types: Case Reports  
PMID: 18506937

18: J Laryngol Otol. 2009 Jan;123(1):80-4. Epub 2008 May 23.

Paranasal sinus barotrauma in sports self-contained underwater breathing apparatus divers.

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**OBJECTIVE:** TO evaluate potential pre-dive parameters in relation to paranasal sinus barotrauma in sports self-contained underwater breathing apparatus divers. **STUDY DESIGN:** The pre-dive and follow-up records of 46 healthy sports self-contained underwater breathing apparatus divers were analysed. **METHODS:** In

the routine pre-dive examination of diving candidates with no symptoms of rhino-sinus disease, rhinoscopy, sinus radiography and nasal endoscopy indicated no signs of rhinitis and/or sinusitis. Any signs of paranasal sinus barotrauma were noted, and several parameters were evaluated in relation to occurrence of barotrauma. RESULTS: Of the studied parameters, a history of sinusitis and of middle-ear barotrauma was significantly more frequent in divers in the barotrauma group ( $p < 0.05$ ). CONCLUSIONS: In divers undergoing a routine pre-dive examination, paranasal sinus barotrauma was not related to sex, alcohol consumption, smoking, decongestant use, mild nasal septal deviation, or inability to perform the Valsalva or Toynbee manoeuvres. However, divers with a history of sinusitis or middle-ear barotrauma may be more prone to paranasal sinus barotrauma. A more detailed pre-dive examination may be useful for such individuals.

PMID: 18501035

19: Undersea Hyperb Med. 2008 Mar-Apr;35(2):131-43.

Pulmonary effects of submerged oxygen breathing in resting divers: repeated exposures to 140 kPa.

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Navy Experimental Diving Unit Panama City, FL, USA.

To detect cumulative effects of and check required recovery times between underwater exposures to 130-140 kPa oxygen, we assessed pulmonary oxygen toxicity after resting dives for four and six hours on two, five, and six or ten days, and three hours twice on each of two days. Despite a slight downward trend in diffusing capacity, four-hour resting dives could be repeated for at least ten days if intervals between them were 20 hours: 17% of divers had mild symptoms; 5%, mild changes in flow-volume parameters. In contrast, six-hour resting dives caused symptoms in 33% of divers. When dives were repeated daily (after 18 hours), but not with one day off (after 42 hours), changes in diffusing capacity accumulated, and hyperoxic myopia occurred after five dives. Divers complained of fatigue more with daily than with alternate day dives. When daily exposure was

split into two three-hour dives, the incidences of symptoms and changes in pulmonary function depended on the surface intervals: on the second day, with two and 16 hours between dives, two three-hour dives were similar to a six-hour dive; with four and 14 hours, to a four-hour dive; with six and 12 hours, to a six-hour dive.

Publication Types: Research Support, U.S. Gov't, Non-P.H.S.

PMID: 18500077

20: Undersea Hyperb Med. 2008 Mar-Apr;35(2):99-106.

Neurological decompression illness and hematocrit: analysis of a consecutive series of 200 recreational scuba divers.

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Division of Neuro-Oncology and Dardinger Neuro-Oncology Center, Ohio State University Medical Center and James Cancer Hospital and Solove Research institute, Columbus, Ohio, USA.

Neurological complications are common in recreational divers diagnosed with decompression illness (DCI). Prior reports suggest that hemoconcentration, with hematocrit values of 48 or greater, increase the risk for more severe and persistent neurological deficits in divers with DCI. Herein we describe our experience with neurological DCI and hematocrit values in a large series of consecutively treated divers. We performed a retrospective chart review of 200 consecutive recreational divers that received treatment for DCI. Standard statistical analyses were performed to determine if there were any significant relationships between diving-related or demographic parameters, neurological manifestations, and hematocrit. In 177 of the 200 divers (88.5%), at least one manifestation of neurological DCI (mild, moderate, or severe) was present. The median hematocrit value was 43, for both male and female divers, with a range of 30 to 61. Hematocrit values did not correlate with diver age or level of diving experience. In male divers, the hematocrit did not correlate with neurological symptoms, including the sub-group with values of 48 or greater. In

contrast, female divers with hematocrit values of 48 or greater were significantly more likely to develop motor weakness ( $p=0.002$ , Fisher's exact test) and an increased number of severe sensory symptoms ( $p=0.001$ , Kendall's tau statistic). Neurological complications are common in recreational divers treated for DCI. Hematocrit values of 48 or higher were correlated with the presence of motor weakness and severity of sensory symptoms in female divers. The hematocrit did not correlate with neurological DCI in male divers.

Publication Types: Research Support, N.I.H., Extramural Research Support, Non-U.S. Gov't  
PMID: 18500074

21: Undersea Hyperb Med. 2008 Mar-Apr;35(2):91-7.

Viewpoint: the type A- and the type B-variants of Decompression Sickness.

Koch AE, Wegner-Bröse H, Warninghoff V, Deuschl G.

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BACKGROUND: Symptoms of neurological decompression incidents (DCS/AGE) can be severe or mild. It is unknown if these differences of symptom presentation represent different clinical entities or if they represent just the spectrum of DCS/AGE. METHODS: 267 cases with DCS/AGE were compared retrospectively and classified into two subgroups, the Type A-DCS/AGE for cases with a severe and often stroke-like symptomatology and the Type B-DCS/AGE for those with milder and sometimes even doubtful neurological symptoms. The main outcome measures were the number of hyperbaric treatments (HTs) needed and the clinical outcome. RESULTS: 42 patients with DCS/AGE were classified as Type A- and 225 patients met the criteria for a Type B-DCS/AGE. Patients with Type A-lesions were more severely affected, needed more hyperbaric treatments and had a less favorable outcome than patients with the Type B-variant. CONCLUSIONS: The Type A- and the Type B-DCS/AGE are likely to be different entities with better clinical outcome in the Type B-variant and possibly significant

differences in the underlying pathophysiologies of both variants. Future studies with a particular focus on the up to now inadequately investigated Type B-DCS/AGE are necessary to elucidate such differences in the pathophysiology.  
PMID: 18500073

22: Undersea Hyperb Med. 2008 Mar-Apr;35(2):83-90.

Cardiac function during breath-hold diving in humans: an echocardiographic study.

Marabotti C, Belardinelli A, L'Abbate A, Scalzini A, Chiesa F, Cialoni D, Passera M, Bedini R.

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Breath-hold diving induces, in marine mammals, a reduction of cardiac output due to a decrease of both heart rate and stroke volume. Cardiovascular changes in humans during breath-hold diving are only partially known due to the technical difficulty of studying fully immersed subjects. Recently, a submersible echocardiograph has been developed, allowing a feasible assessment of cardiac anatomy and function of subjects during diving. Aim of the study was to evaluate, by Doppler-echocardiography, the cardiovascular changes induced by breath-hold diving in humans. Ten male subjects were studied by Doppler echocardiography in dry conditions and during breath-hold diving at 3 m depth. In addition 14 male subjects were studied, using the same protocol, before and during breath-hold diving at 10 m depth. At 3 m depth significant reductions in heart rate (-17%), stroke volume (-17%), cardiac output (-29%), left atrial dimensions, and deceleration time of early diastolic transmitral flow (DTE) were observed. At 10 m depth similar but more pronounced changes occurred. In particular, increase in early transmitral flow velocity became significant (+33%), while DTE decreased by 34%. At both depths dimensions of right cardiac chambers remained unchanged. Breath-hold diving at shallow depth induced, in humans, cardiovascular changes qualitatively similar to those observed in natural divers such as seals. The reduced dimensions of left atrium associated to a left ventricular diastolic

pattern resembling that of restrictive/constrictive heart disease, suggest that the hemodynamic effects of diving could be explained, at least in part, by a constriction exerted on the heart by the reduced chest volume and the increased blood content of the lungs. Finally, the absence of dimensional changes in the right chambers suggests that most of the pulmonary blood shift occurred before cardiac imaging.  
PMID: 18500072

23: Undersea Hyperb Med. 2008 Mar-Apr;35(2):79-82.

Ocular tear film bubble formation after breath-hold diving.

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School of Physical Education and Sport Sciences, University of Bedfordshire, Luton, UK.

Bubbles in the ocular tear film have been observed following both dry-chamber, simulated compressed air dives and in-water, recreational compressed air dives. The current paper reports on the formation of tear film bubbles in a breath-hold diver following repeated, extended breath-hold excursions to a maximum depth of -28.5 m. It is believed that this is the first time that ocular tear film bubbles have been reported in breath-hold divers.

Publication Types: Case Reports  
PMID: 18500071

24: Eur J Appl Physiol. 2008 Sep;104(1):1-7. Epub 2008 May 22.

Heart rate and blood pressure time courses during prolonged dry apnoea in breath-hold divers.

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To define the dynamics of cardiovascular adjustments to apnoea, beat-to-beat heart rate (HR) and blood pressure and arterial oxygen saturation (SaO<sub>2</sub>) were recorded during prolonged breath-holding in air in 20 divers. Apnoea had a mean duration of 210 +/- 70 s. In all subjects, HR attained a value 14 beats min<sup>-1</sup> lower than control within the initial 30 s (phase I). HR did not change for the following

2-2.5 min (phase II). Then, nine subjects interrupted the apnoea (group A), whereas 11 subjects (group B) could prolong the breath-holding for about 100 s, during which HR continuously decreased (phase III). In both groups, mean blood pressure was 8 mmHg above control at the end of phase I; it then further increased by additional 12 mmHg at the end of the apnoea. In both groups, SaO<sub>2</sub> did not change in the initial 100-140 s of apnoea; then, it decreased to 95% at the end of phase II. In group B, SaO<sub>2</sub> further diminished to 84% at the end of phase III. A typical pattern of cardiovascular readjustments was identified during dry apnoea. This pattern was not compatible with a role for baroreflexes in phase I and phase II. Further readjustment in group B may imply a role for both baroreflexes and chemoreflexes. Hypothesis has been made that the end of phase II corresponds to physiological breakpoint.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18496707

25: J Oral Maxillofac Surg. 2008 Jun;66(6):1317-9.

Zygomatic fracture in a diver: postoperative considerations.

Tuncer S, Cizmeci O.

Publication Types: Case Reports  
Letter  
PMID: 18486806

26: Health Promot J Austr. 2008 Apr;19(1):68-71.

Taking the plunge: diving risk practices and perceptions of New Zealand youth.

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ISSUE ADDRESSED: In New Zealand, spinal cord injuries as a consequence of recreational diving have not been well investigated. From 1989-2004, 58 hospital admissions involved diving-related spinal injury. More than 70% were male and more than one-third (36%) were aged 10-19 years. Little is known, however, about the extent of risky diving beliefs and behaviours underpinning youth aquatic recreation. METHOD: A New Zealand-wide sample of 2,202 Year 11

students completed a written questionnaire under supervision during school time. Diving behaviours and safety attitudes were analysed using a range of sociodemographic variables including gender, socio-economic status and ethnicity.

**RESULTS:** Gender differences in risky behaviour and unsafe attitudes were pronounced, whereas the influence of socio-economic status and ethnic background were less evident. More females than males reported "never diving head first into water of unknown depth" (females 75%, males 59%). More males reported "diving head first knowing that the water was shallow" (males 25%, females 14%). More females disagreed that diving head first into shallow water was acceptable if you knew how to dive (females 82%, males 66%).

**CONCLUSIONS:** Males, students from low decile schools and of Maori and Pacific Island backgrounds were most likely to hold unsafe attitudes towards diving and report risky diving behaviours.

**Publication Types:** Research Support, Non-U.S. Gov't  
PMID: 18481936

27: Spinal Cord. 2008 Nov;46(11):743-7. Epub 2008 May 13. Venous gas bubble formation and decompression risk after scuba diving in persons with chronic spinal cord injury and able-bodied controls.

Breskovic T, Denoble P, Palada I, Obad A, Valic Z, Glavas D, Bakovic D, Dujic Z.

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**STUDY DESIGN:** Prospective study. **OBJECTIVE:** To evaluate the formation of venous gas bubbles following open-sea scuba dives in persons with chronic spinal cord injury (SCI) and in able-bodied diving instructors (C) and to assess the risk for decompression sickness (DCS). **SETTING:** Field study at the Island of Krk, Croatia. **METHODS:** Gas bubbles were monitored with an ultrasound scanner 40 min after surfacing. The probability of DCS (P((DCS))) was estimated from the recorded depth-time profile using a decompression model. **RESULTS:** Divers completed six dives in 3 days using

a modified Bühlmann decompression model, and none developed signs of DCS. Mean P((DCS)) was similar in both groups, SCI (0.51+/-0.2%) and C (0.64+/-0.27%), and was seen to increase with subsequent dives. Number of bubbles (bubbles per cm(2)) was low in both groups on all 3 days of diving. **CONCLUSIONS:** We have used the P((DCS)) as a severity index of diving exposure. Overall, the severity of exposure in SCI subjects was consistent with the range of typical recreational dives, suggesting that the diving profile used is very safe.

**Publication Types:** Clinical Trial  
Research Support, Non-U.S. Gov't  
PMID: 18475278

28: J Appl Physiol. 2009 Jan;106(1):293-7. Epub 2008 May 8.

Cardiac changes induced by immersion and breath-hold diving in humans.

Marabotti C, Scalzini A, Cialoni D, Passera M, L'Abbate A, Bedini R.

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To evaluate the separate cardiovascular response to body immersion and increased environmental pressure during diving, 12 healthy male subjects (mean age 35.2 +/- 6.5 yr) underwent two-dimensional Doppler echocardiography in five different conditions: out of water (basal); head-out immersion while breathing (condition A); fully immersed at the surface while breathing (condition B) and breath holding (condition C); and breath-hold diving at 5-m depth (condition D). Heart rate, left ventricular volumes, stroke volume, and cardiac output were obtained by underwater echocardiography. Early (E) and late (A) transmitral flow velocities, their ratio (E/A), and deceleration time of E (DTE) were also obtained from pulsed-wave Doppler, as left ventricular diastolic function indexes. The experimental protocol induced significant reductions in left ventricular volumes, left ventricular stroke volume (P < 0.05), cardiac output (P < 0.001), and heart rate (P < 0.05). A significant increase in E peak (P < 0.01) and E/A (P < 0.01) and a

significant reduction of DTE ( $P < 0.01$ ) were also observed. Changes occurring during diving (condition D) accounted for most of the changes observed in the experimental series. In particular, cardiac output at condition D was significantly lower compared with each of the other experimental conditions, E/A was significantly higher during condition D than in conditions A and C. Finally, DTE was significantly shorter at condition D than in basal and condition C. This study confirms a reduction of cardiac output in diving humans. Since most of the changes were observed during diving, the increased environmental pressure seems responsible for this hemodynamic rearrangement. Left ventricular diastolic function changes suggest a constrictive effect on the heart, possibly accounting for cardiac output reduction.  
PMID: 18467547

29: Klin Monatsbl Augenheilkd. 2008 May;225(5):430-1.  
[Intraorbital haematoma while scuba diving--a case report]  
[Article in German]  
Bianda J, von Arx G, Chaloupka K. Augenklinik, Universitätsspital Zürich, Zürich, Schweiz.  
BACKGROUND: Intraorbital haematoma while scuba diving is a rare finding after barotrauma. MATERIAL AND METHODS: Case report. RESULTS: A 36-year-old woman presented with a swelling of the left lid after having dived to 10 m below sea level. The CT scan and MR imaging of the head revealed a retrobulbar intraconal haemorrhage within the left orbit. Three months after the accident the patient did not have any complaints, angiography could not detect any intracerebral vascular anomalies. As a complicating risk factor the patient had fibrous constrictions of both Eustachian tubes rendering the compulsory nasopharyngeal decompression process during scuba diving impossible. CONCLUSION: Vascular intracerebral anomalies which could be the potential cause for the described retrobulbar haemorrhage must be excluded so as to reduce the risk of recurrence.

Publication Types: Case Reports  
English Abstract  
PMID: 18454388

30: Naturwissenschaften. 2008 Sep;95(9):793-801. Epub 2008 Apr 30.  
Decompression syndrome and the evolution of deep diving physiology in the Cetacea.  
Beatty BL, Rothschild BM. New York College of Osteopathic Medicine, Old Westbury, NY 11568, USA. bbeatty@nyit.edu  
Whales repetitively dive deep to feed and should be susceptible to decompression syndrome, though they are not known to suffer the associated pathologies. Avascular osteonecrosis has been recognized as an indicator of diving habits of extinct marine amniotes. Vertebrae of 331 individual modern and 996 fossil whales were subjected to macroscopic and radiographic examination. Avascular osteonecrosis was found in the Oligocene basal odontocetes (Xenorophoidea) and in geologically younger mysticetes, such as Aglaocetus [a sister taxon to Balaenopteridae + (Balaenidae + Eschrichtiidae) clade]. These are considered as early "experiments" in repetitive deep diving, indicating that they independently converged on their similar specialized diving physiologies.  
PMID: 18446257

31: Respir Physiol Neurobiol. 2008 May 31;161(3):298-305. Epub 2008 Mar 14.  
Tracheal compression delays alveolar collapse during deep diving in marine mammals.  
Bostrom BL, Fahlman A, Jones DR. Department of Zoology, University of British Columbia, 6270 University Boulevard, Vancouver, B.C. V6T 1Z4, Canada. bostrom@zoology.ubc.ca  
Marine mammals have very compliant alveoli and stiff upper airways; an adaptation that allows air to move from the alveoli into the upper airways, during breath-hold diving. Alveolar collapse is thought occur between 30 and 100 m and studies that have attempted to estimate gas exchange at depth have used the simplifying assumption that gas exchange ceases abruptly at the alveolar collapse depth. Here we develop a mathematical model that uses compliance values for the

alveoli and upper airspaces, estimated from the literature, to predict volumes of the respiratory system at depth. Any compressibility of the upper airways decreases the volume to contain alveolar air yielding lung collapse pressures 2x that calculated assuming an incompressible upper airway. A simple relationship with alveolar volume was used to predict relative pulmonary shunt at depth. The results from our model agree with empirical data on gas absorption at depth as well as the degree of tracheal compression in forced and free diving mammals.

Publication Types: Research Support, Non-U.S. Gov't  
Research Support, U.S. Gov't, Non-P.H.S.  
PMID: 18430614

32: *Physiol Biochem Zool.* 2008 May-Jun;81(3):301-9.

Thermal plasticity of diving behavior, aquatic respiration, and locomotor performance in the Mary River turtle *Elusor macrurus*.

Clark NJ, Gordos MA, Franklin CE. School of Integrative Biology, University of Queensland, Brisbane, Queensland, Australia.

Locomotion is a common measure of performance used in studies of thermal acclimation because of its correlation with predator escape and prey capture. However, for sedentary animals such as freshwater turtles, we propose that diving behavior may be a more ecologically relevant measure of performance. Increasing dive duration in hatchling turtles reduces predator exposure and therefore functions as an ecological benefit. Diving behavior is thermally dependent, and in some species of freshwater turtles, it is also reliant on aquatic respiration. This study examined the influence of thermal acclimation on diving behavior, aquatic respiration, and locomotor performance in the endangered, bimodally respiring Mary River turtle *Elusor macrurus*. Diving behavior was found to partially acclimate at 17 degrees C, with turtles acclimated to a cold temperature (17 degrees C) having a significantly longer dive duration than hatchlings acclimated to a warm temperature (28 degrees C). This increase in dive duration at 17 degrees C was not a result of

physiological alterations in metabolic rate but was due instead to an increase in aquatic oxygen consumption. Increasing aquatic oxygen consumption permitted cold-acclimated hatchlings to remain submerged for significantly longer periods, with one turtle undertaking a dive of over 2.5 d. When burst-swimming speed was used as the measure of performance, thermal acclimation was not detected. Overall, *E. macrurus* demonstrated a partial ability to acclimate to changes in environmental temperature.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18419556

33: *HNO.* 2008 May;56(5):489.

[Diving medicine. ENT specialists' expertise needed and required]

[Article in German]

Klingmann C.

Publication Types: Editorial  
PMID: 18415067

34: *HNO.* 2008 May;56(5):499-504, 506-8.

[Otorhinolaryngologic disorders associated with diving]

[Article in German]

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The number of Germans practicing sea diving has grown, so doctors are increasingly confronted with questions pertaining to diving. They concern not only patient fitness but also prevention and therapy of associated disorders and disease. This article describes predisposing factors and otologic, rhinologic, and laryngologic problems associated with diving. The most common medical problem is inflammation of the external auditory canal; the most common -Barotrauma is to the middle ear. Case studies are used to demonstrate these and other disorders associated with diving.

Publication Types: English Abstract Review  
PMID: 18415066

35: *HNO.* 2008 May;56(5):509-18.

[Fitness to dive in the otorhinolaryngological field]  
[Article in German]

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In line with the rising number of recreational divers, the otorhinolaryngologist has to deal with growing numbers of diving-associated disorders of the ear, nose and throat (ENT). Nevertheless, the majority of divers present to their ENT doctor for assessment of their fitness to dive. On the basis of long-term follow-up examinations and increasing experience in diving medicine, even divers with a history of ENT problems can be considered fit to dive. Therefore, diving is possible after tympanoplasty, surgery to improve hearing including stapesplasty, after implantation of middle ear amplifiers or cochlear implants, after sinus or scull base surgery and even after canal wall down mastoidectomy, provided that certain requirements are fulfilled. Assessing fitness to dive after inner ear barotrauma as well as after inner ear decompression illness requires meticulous consideration of residual damage and possible underlying conditions like vascular right-to-left shunts. This article is based on the new recommendations of the German Undersea and Hyperbaric Medical Society for the assessment of fitness to dive in the otorhinolaryngological field.

Publication Types: English  
Abstract Review  
PMID: 18415065

36: Ugeskr Laeger. 2008 Mar 31;170(14):1142.

[Diving sickness]

[Article in Danish]

Barfod C, Bertelsen B.

Navalmedicinsk sektion, Forsvarets Sundhedstjeneste. barfod@dadlnet.dk  
PMID: 18405476

37: J Exp Biol. 2008 Apr;211(Pt 8):1169-79.

Heart rate regulation and extreme bradycardia in diving emperor penguins.

Meir JU, Stockard TK, Williams CL, Ponganis KV, Ponganis PJ.

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To investigate the diving heart rate ( $f(H)$ ) response of the emperor penguin (*Aptenodytes forsteri*), the consummate avian diver, birds diving at an isolated dive hole in McMurdo Sound, Antarctica were outfitted with digital electrocardiogram recorders, two-axis accelerometers and time depth recorders (TDRs). In contrast to any other freely diving bird, a true bradycardia ( $f(H)$  significantly  $< f(H)$  at rest) occurred during diving [dive  $f(H)$  (total beats/duration) =  $57 \pm 2$  beats  $\text{min}^{-1}$ ,  $f(H)$  at rest =  $73 \pm 2$  beats  $\text{min}^{-1}$  (mean  $\pm$  s.e.m.)]. For dives less than the aerobic dive limit (ADL; duration beyond which [blood lactate] increases above resting levels), dive  $f(H) = 85 \pm 3$  beats  $\text{min}^{-1}$ , whereas  $f(H)$  in dives greater than the ADL was significantly lower ( $41 \pm 1$  beats  $\text{min}^{-1}$ ). In dives greater than the ADL,  $f(H)$  reached extremely low values:  $f(H)$  during the last 5 mins of an 18 min dive was 6 beats  $\text{min}^{-1}$ . Dive  $f(H)$  and minimum instantaneous  $f(H)$  during dives declined significantly with increasing dive duration. Dive  $f(H)$  was independent of swim stroke frequency. This suggests that progressive bradycardia and peripheral vasoconstriction (including isolation of muscle) are primary determinants of blood oxygen depletion in diving emperor penguins. Maximum instantaneous surface interval  $f(H)$  in this study is the highest ever recorded for emperor penguins (256 beats  $\text{min}^{-1}$ ), equivalent to  $f(H)$  at  $V(O_2)$  max., presumably facilitating oxygen loading and post-dive metabolism. The classic Scholander-Irving dive response in these emperor penguins contrasts with the absence of true bradycardia in diving ducks, cormorants, and other penguin species.

Publication Types: Research Support, Non-U.S. Gov't  
Research Support, U.S. Gov't, Non-P.H.S.  
PMID: 18375841

38: *Ecol Appl.* 2008 Jan;18(1):258-72.

Functional response of sport divers to lobsters with application to fisheries management.

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Fishery managers must understand the dynamics of fishers and their prey to successfully predict the outcome of management actions. We measured the impact of a two-day exclusively recreational fishery on Caribbean spiny lobster in the Florida Keys, USA, over large spatial scales (>100 km) and multiple years and used a theoretical, predator-prey functional response approach to identify whether or not sport diver catch rates were density-independent (type I) or density-dependent (type II or III functional response), and if catch rates were saturated (i.e., reached an asymptote) at relatively high lobster densities. We then describe how this predator-prey framework can be applied to fisheries management for spiny lobster and other species. In the lower Keys, divers exhibited a type-I functional response, whereby they removed a constant and relatively high proportion of lobsters (0.74-0.84) across all pre-fishing-season lobster densities. Diver fishing effort increased in a linear manner with lobster prey densities, as would be expected with a type-I functional response, and was an order of magnitude lower in the upper Keys than lower Keys. There were numerous instances in the upper Keys where the density of lobsters actually increased from before to after the fishing season, suggesting some type of "spill-in effect" from surrounding diver-disturbed areas. With the exception of isolated reefs in the upper Keys, the proportion of lobsters removed by divers was density independent (type-I functional response) and never reached saturation at natural

lobster densities. Thus, recreational divers have a relatively simple predatory response to spiny lobster, whereby catch rates increase linearly with lobster density such that catch is a reliable indicator of abundance. Although diver predation is extremely high (approximately 80%), diver predation pressure is not expected to increase proportionally with a decline in lobster density (i.e., a compensatory response), which could exacerbate local extinction. Furthermore, management actions that reduce diver effort should have a concomitant and desired reduction in catch. The recreational diver-lobster predator-prey construct in this study provides a useful predictive framework to apply to both recreational and commercial fisheries, and on which to build as management actions are implemented.  
Publication Types: Research Support, Non-U.S. Gov't  
Research Support, U.S. Gov't, Non-P.H.S.  
PMID: 18372571

39: *Comput Biol Med.* 2008 May;38(5):583-600. Epub 2008 Mar 26.  
Statistical correlations and risk analyses techniques for a diving dual phase bubble model and data bank using massively parallel supercomputers.

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Linking model and data, we detail the LANL diving reduced gradient bubble model (RGBM), dynamical principles, and correlation with data in the LANL Data Bank. Table, profile, and meter risks are obtained from likelihood analysis and quoted for air, nitrox, helitrox no-decompression time limits, repetitive dive tables, and selected mixed gas and repetitive profiles. Application analyses include the EXPLORER decompression meter algorithm, NAUI tables, University of Wisconsin Seafood Diver tables, comparative NAUI, PADI, Oceanic NDLs and repetitive dives, comparative nitrogen and helium mixed gas risks, USS Perry

deep rebreather (RB) exploration dive, world record open circuit (OC) dive, and Woodville Karst Plain Project (WKPP) extreme cave exploration profiles. The algorithm has seen extensive and utilitarian application in mixed gas diving, both in recreational and technical sectors, and forms the bases for released tables and decompression meters used by scientific, commercial, and research divers. The LANL Data Bank is described, and the methods used to deduce risk are detailed. Risk functions for dissolved gas and bubbles are summarized. Parameters that can be used to estimate profile risk are tallied. To fit data, a modified Levenberg-Marquardt routine is employed with L2 error norm. Appendices sketch the numerical methods, and list reports from field testing for (real) mixed gas diving. A Monte Carlo-like sampling scheme for fast numerical analysis of the data is also detailed, as a coupled variance reduction technique and additional check on the canonical approach to estimating diving risk. The method suggests alternatives to the canonical approach. This work represents a first time correlation effort linking a dynamical bubble model with deep stop data. Supercomputing resources are requisite to connect model and data in application.  
PMID: 18371945

40: Eur J Appl Physiol. 2008 Sep;104(2):237-44. Epub 2008 Mar 28. Effects of pressure, cold and gloves on hand skin temperature and manual performance of divers.  
Zander J, Morrison J.  
School of Kinesiology, Simon Fraser University, Burnaby, BC, V5A 1S6, Canada.  
Cold water immersion and protective gloves are associated with decreased manual performance. Although neoprene gloves slow hand cooling, there is little information on whether they provide sufficient protection when diving in cold water. Nine divers wearing three-fingered neoprene gloves and dry suits were immersed in water at 25 and 4 degrees C, at depths of 0.4 msw (101 kPa altitude adjusted) and 40 msw (497 kPa) in a hyperbaric chamber. Skin temperatures were

measured at the fingers, hand, forearm, chest and head. Grip strength, tactile sensitivity and manual dexterity were measured at three time intervals. There was an exponential decay in finger and back of hand skin temperatures with exposure time in 4 degrees C water. Finger and back of hand skin temperatures were lower at 40 msw than at 0.4 msw ( $P < 0.05$ ). There was no effect of pressure or temperature on grip strength. Tactile sensitivity decreased linearly with finger skin temperature at both pressures. Manual dexterity was not affected by finger skin temperature at 0.4 msw, but decreased with fall in finger skin temperature at 40 msw. Results show that neoprene gloves do not provide adequate thermal protection in 4 degrees C water and that impairment of manual performance is dependent on the type of task, depth and exposure time.  
Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18369658

41: Fiziol Cheloveka. 2008 Jan-Feb;34(1):114-25.  
[Effects of various hyperbaric gas mixtures on hormonal parameters of healthy human blood and saliva]  
[Article in Russian]  
Popova IuA, Buravkova LB, Larina IM, Pavlov BN.  
Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18365643

42: Heart. 2008 Apr;94(4):445.  
Bubbles in the left cardiac cavities after diving.  
Boussuges A, Blatteau JE, Pontier JM.  
alainboussuges@libertysurf.fr  
Publication Types: Case Reports  
PMID: 18347375

43: J Laryngol Otol. 2008 Nov;122(11):1162-7. Epub 2008 Mar 18.  
Prevalence and severity of external auditory exostoses in breath-hold divers.  
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**OBJECTIVE:** To explore the prevalence and severity of external auditory exostoses in a population of experienced breath-hold divers, and to compare these to the same parameters within surfing and self-contained underwater breathing apparatus diving populations. **DESIGN:** A stepwise, multiple regression analysis of cross-sectional data examining the relative contributions of sea surface temperature, latitude of exposure and years of exposure to the prevalence and severity of stenosis due to external auditory exostoses. A chi-square analysis of the prevalence and severity of external auditory exostosis stenosis in the breath-hold divers was compared with previously published data for surfers and self-contained underwater breathing apparatus divers. **SUBJECTS:** Seventy-six male and thirty-five female breath-hold divers attending an international 'freedive' competition completed a questionnaire describing aquatic sports habits, geography of participation and symptomatology. Those completing the questionnaire (111/154 attendees) were examined otoscopically for evidence of external auditory exostoses. Images were digitally recorded, scored and graded. **RESULTS:** Exostoses were evident in 87.7 per cent of the 204 ears scored and graded for severity of stenosis due to external auditory exostoses. The prevalence of exostoses was no different from that found in previous studies of surfers and self-contained underwater breathing apparatus divers ( $p = 0.101$ ). However, the pattern of affliction was more similar to that found in surfers. The severity of exostoses was significantly less than that found in surfing populations ( $p < \text{or} = 0.001$  to  $0.007$ ), but greater than that found in self-contained underwater breathing apparatus diving populations ( $p < \text{or} = 0.001$ ). Sea surface temperature at the location of open-water exposure was the most significant predictor of the prevalence and severity of external auditory exostoses in breath-hold divers ( $p = 0.019$ ). **CONCLUSION:** The prevalence and severity patterns of stenosis due to external auditory exostoses in breath-hold divers are

more similar to previously published results for surfing populations than to previously published results for self-contained underwater breathing apparatus diving populations. In breath-hold divers, sea surface temperature is the strongest predictor of severity of stenosis due to external auditory exostoses.

PMID: 18346299

44: Acta Otorrinolaringol Esp. 2008 Feb;59(2):70-5.

[Auditory threshold in professional divers not exposed to noise]

[Article in Spanish]

Herranz González-Botas J, Fojón Polanco S, López Facal MS, Fernández Casabella C, García Casás M.

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**OBJECTIVES:** Otologic and audiometric evaluation of professional divers without noise exposure has been carried out to analyze the repercussions of this activity on their hearing. **MATERIAL AND METHOD:** A total of 233 professional divers, working in a no noise environment, with an average experience of 9.6 years and 2074 lifetime dives, in a working depth between 10 m and 27 m, average 4.6 hours underwater time were evaluated. This atypical population of divers did not follow any decompression schedule and engaged in diving in a purely empirical and intuitive fashion. **RESULTS:** Eighty-nine point two per cent presented symptoms of decompression sickness (DCS). Only 19.7% presented a mean hearing threshold below 20 dB while 73.5% had a mild hearing loss. Significant differences ( $P < .0001$ ) were found in hearing thresholds at 3, 4, and 6 kHz when hearing thresholds were grouped by years of experience and diver's age. No such increase was found when the sample was grouped by DCS symptoms, vestibular symptoms, number of dives, or patent foramen ovale. **CONCLUSIONS:** The presence of high-frequency sensorineural hearing loss in professional divers is related to their age and experience, even without a noisy working environment.

Publication Types: English Abstract  
Research Support, Non-U.S. Gov't

PMID: 18341863

45: Sports Biomech. 2008  
Jan;7(1):100-13.

Front- or rear-weighted track start or grab start: which is the best for female swimmers?

Welcher RL, Hinrichs RN, George TR. Exercise and Sport Research Institute, Department of Kinesiology, Arizona State University, Tempe, AZ 85287-0404, USA.

The aim of this study was to compare three competitive swimming starts (grab, rear-weighted track, and front-weighted track). The starts were compared in terms of time and instantaneous horizontal velocity, both at take-off from the block and at 5 m from the wall. Twenty US college female swimmers performed three trials of each of the three randomly ordered starts. Swimmers left the block significantly sooner using the front-weighted track start (0.80 s) than the other two starts (both 0.87 s;  $P < 0.001$ ). In the rear-weighted track start, however, the athletes left the blocks with significantly higher horizontal velocity than in the grab or front-weighted track start (3.99 vs. 3.87 and 3.90 m/s, respectively; each  $P < 0.001$ ). By 5 m, the front-weighted track start maintained its time advantage over the grab start (2.19 vs. 2.24s;  $P = 0.008$ ) but not the rear-weighted track start (2.19 vs. 2.21 s;  $P = 0.336$ ). However, the rear-weighted track start had a significant advantage over the front-weighted track start in terms of instantaneous horizontal velocity at 5 m (2.25 vs. 2.18 m/s;  $P = 0.009$ ). Therefore, the rear-weighted track start had a better combination of time and velocity than the front-weighted track start. There was also a trend for the rear-weighted track start to have higher velocity at 5 m than the grab start, although this did not reach statistical significance (2.25 vs. 2.20 m/s;  $P = 0.042$ ). Overall, these results favour the rear-weighted track start for female swimmers even though most of the athletes had little or no prior experience with it. Additional research is needed to determine whether males would respond similarly to females in these three different swimming starts.

PMID: 18341139

46: Respir Physiol Neurobiol. 2008  
Apr 30;161(2):174-81. Epub 2008 Feb 7.

Restoration of hemodynamics in apnea struggle phase in association with involuntary breathing movements.

Palada I, Bakovic D, Valic Z, Obad A, Ivancev V, Eterovic D, Shoemaker JK, Dujic Z.

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Involuntary breathing movements (IBM) that occur in the struggle phase of maximal apneas produce waves of negative intrathoracic pressure. This could augment the venous return, increasing thereby the cardiac output and gas exchange, and release the fresh blood from venous pools of spleen and liver. To test these hypotheses we used photoplethysmography and ultrasound for assessment of hemodynamics and spleen size before, during and after maximal dry apneas at large lung volume in 7 trained divers. During the easy-going phase cardiac output was reduced about 40%, due to reduction in stroke volume and in presence of reduced inferior vena cava venous return, while the spleen contracted for about 60 ml. Towards the end of the struggle phase, in presence of intense IBM, the spleen volume further decreased for about 70 ml, while cardiac output and caval flow almost renormalized. In conclusion, IBM coincide with splenic volume reduction and restoration of hemodynamics, likely facilitating the use of the last oxygen reserves before apnea cessation.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18337193

47: Accid Anal Prev. 2008  
Mar;40(2):787-97. Epub 2007 Oct 8.

Risk factors and prevention for spinal cord injury from diving in swimming pools and natural sites in Quebec, Canada: a 44-year study.

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BACKGROUND: Diving is the most frequent cause of spinal cord injury

(SCI) from recreation and sport in Canada. This study was done to identify risk factors for SCI from diving in the province of Quebec. METHODS: An interview survey was done for a target population of 203 subjects with a SCI from diving treated in the two specialized rehabilitation centers in Quebec during 1961-2004. Telephone interviews of consenting individuals were used to collect pertinent personal, equipment, and environmental factors for each incident. RESULTS: Response was 44% (89/203); 92% were male and 85% <35 years old. Only 37% were aware prior to injury of the risk of SCI from diving, and only 33% had received water safety training. Swimming pools were the site of 51% (n=45) and natural bodies of water for 49% (n=44). 87% (n=39) of pools were single-unit home pools and 57% (n=26) above-ground. Depth indicators were absent for 100% of above-ground and 74% of in-ground pools. For SCI in in-ground pools, 63% resulted from striking the up-slope between deep and shallow ends. For dives at natural sites, a dock or wharf was the most frequent location, 36% (n=16). In 52% of pools and 79% of natural sites, depth was <1.4m (4.6ft). Signs prohibiting diving were absent in 96% of above-ground and 89% of in-ground pools. Alcohol was reported in 47% of SCIs. INTERPRETATION: The target for prevention of diving SCI is male youths and young adults. Above-ground pools are too shallow and small for diving. Deep ends of many in-ground pools are excessively shallow and short since many SCIs resulted from striking the up-slope. Prevention of SCI from diving needs to focus on education of potential victims, pool vendors and manufacturers, and regulations for safety norms in private pools. Water safety should highlight diving as a high-risk activity, and emphasize that most home pools and natural sites are unsafe. Safer evidence-based pool designs and more effective warnings need to be implemented.

PMID: 18329434

48: Aviat Space Environ Med. 2008 Feb;79(2):123-8.

Comment in: Aviat Space Environ Med. 2008 Aug;79(8):797-8.

Decompression illness reported in a survey of 429 recreational divers. Klingmann C, Gonnermann A, Dreyhaupt J, Vent J, Praetorius M, Plinkert PK.

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BACKGROUND: The purpose of this study was to investigate the influence of diving experience and diving techniques on the lifetime incidence of decompression illness (DCI). METHODS: Attendants of three diving medical symposia voluntarily answered a questionnaire about their age, gender, medical history, diving experience, diving habits, diving certification levels, and diving associated incidents (cross-sectional survey). RESULTS: Out of 650 divers, 429 completed the questionnaire. The study population consisted of experienced divers with an average of 670 dives. The majority of the divers were certified diving instructors (43%). There were 37 participants (8.7%) who were classified as technical divers with an average of 1193 logged dives. There was an overall lifetime incidence of DCI of 1 per 5463 dives. The complete study group showed an increased lifetime incidence of DCI with decreased diving experience (1.97-fold to 8.17-fold higher). Of the divers, 27% reported severe DCI with neurological symptoms. The lifetime incidence for severe DCI was 1 in 20,291 dives. Again, lifetime incidence for severe DCI was increased with decreased diving certification level (1.1-fold to 13.7-fold higher). Technical divers showed a DCI lifetime incidence of 1 to 8591 dives compared to the non-technical divers with a lifetime incidence of 1 to 5077 dives (not significant). CONCLUSION: In our study population, the lifetime incidence of DCI was increased in divers with less diving experience. If further studies confirm this finding, diving federations should be encouraged to intensify their efforts of educating divers and

should limit diving time and depth in inexperienced divers.  
PMID: 18309910

49: *Aviat Space Environ Med.* 2008 Feb;79(2):99-104.

Static apnea effect on heart rate and its variability in elite breath-hold divers.

Lemaître F, Buchheit M, Joulia F, Fontanari P, Tourny-Chollet C. Centre d'Etudes des Transformations des Activités Physiques et Sportives, Equipe d'Accueil, Faculté des Sciences du Sport et de l'Education Physique de Rouen, Université de Rouen, France. frederic.lemaitre@univ-rouen.fr

**BACKGROUND:** The diving response includes cardiovascular adjustments known to decrease oxygen uptake and thus prolong apnea duration. As this diving response is in part characterized by a pronounced decrease in heart rate (HR), it is thought to be vagally mediated. **METHODS:** In five professional breath-hold divers (BHDs) and five less-trained controls (CTL), we investigated whether the diving response is in fact associated with an increase in the root mean square successive difference of the R-R intervals (RMSSD), a time-domain heart rate variability (HRV) index. HR behavior and arterial oxygen saturation (SaO<sub>2</sub>) were continuously recorded during one maximal apnea. Short-term changes in SaO<sub>2</sub>, HR, and RMSSD were calculated over the complete apnea duration. **RESULTS:** BHDs presented bi-phasic HR kinetics, with two HR decreases (32 +/- 17% and 20 +/- 10% of initial HR). The second HR decrease, which was concomitant to the pronounced SaO<sub>2</sub> decrease, was also simultaneous to a marked increase in RMSSD. CTL showed only one HR decrease (50 +/- 10% of initial HR), which appeared before the concomitant SaO<sub>2</sub> and RMSSD changes. When all subject data were combined, arterial desaturation was positively correlated with total apnea time ( $r = 0.87$ ,  $P < 0.01$ ). **CONCLUSION:** This study indicates that baroreflex stimulation and hypoxia may be involved in the bi-phasic HR response of BHDs and thus in their longer apnea duration.

PMID: 18309906

50: *J Morphol.* 2008 Jun;269(6):734-44.

Skating and diving: Changes in functional morphology of the setal and microtrichial cover during ontogenesis in *Aquarius paludum fabricius* (Heteroptera, Gerridae). Goodwyn PJ, Voigt D, Fujisaki K. Kyoto University, Graduate School of Agriculture, Laboratory of Insect Ecology, Kyoto 606-8414, Japan. pablogoodwyn@yahoo.com.br

We examined the morphology of setae and microtrichia in *Aquarius paludum* during larval development using a scanning electron microscope. We then conducted immersion experiments with larvae and adults in oxygenated and deoxygenated water. The adult water strider body is covered by a pilose double layer consisting of upper long setae (30-80 microm) and lower filiform microtrichia (5-9 microm). Only setae are present on the legs. Microtrichia on the larval body are very short: 0.5-0.6 microm in first and second instars, and 0.8-1.7 microm in third to fifth instars. Larval body setae are approximately as long as those of adults (25-50 microm), but are much less dense at 1,800-5,750 setae per mm<sup>2</sup> versus 15,000-20,000 setae per mm<sup>2</sup> in adults. The density of setae on the legs remains relatively constant throughout development (larvae: 15,000-20,000 setae per mm<sup>2</sup>; adults: 20,000-26,000 setae per mm<sup>2</sup>). Immersion experiments demonstrated that young instars may use cuticular respiration. First- and second-instar larvae survived underwater for several hours without a visible air supply, although they did not survive in deoxygenated water. We posit that the short body microtrichia have a waterproofing function in larvae, whereas they create a compressible air bubble in adults. In adults, waterproofing is accomplished by the setae. The density and length of setae on the legs of larvae was nearly the same as that on the body and legs of adults and is presumably optimized for waterproofing. Thus, a change in morphometrical parameters can result in a large functional change in the same structure. We discuss this interpretation in both ecological and physiological contexts. 2008 Wiley-Liss, Inc

Publication Types: Research  
Support, Non-U.S. Gov't  
PMID: 18302188

51: Scand J Med Sci Sports. 2009 Feb;19(1):87-91. Epub 2008 Feb 21. Arterial oxygen saturation and diving response during dynamic apneas in breath-hold divers. Andersson JP, Evaggelidis L. Department of Cell and Organism Biology, Lund University, Lund, Sweden. Johan.Andersson@cob.lu.se Competitive breath-hold divers try to achieve maximum times, depths, or distances underwater, thereby risking hypoxic syncope. In the present study, the cardiorespiratory responses to dynamic apnea (simultaneously initiated apneas and dynamic leg exercise) were investigated in 10 breath-hold divers. The divers performed 60 s dynamic apneas with the face in air (A) or face immersed in cold water (AFI). During apneas, the arterial oxygen saturation was reduced (A: -10%), but to a lesser extent during AFI (-6%,  $P < 0.01$ ), reaching a nadir 10-15 s post-apnea. Also, changes in end-tidal  $O_2$  and  $CO_2$  pressures ( $P_{et}O_2/P_{et}CO_2$ ) were smaller during AFI than A ( $\Delta P_{et}O_2$ : 8.2 vs 8.7 kPa,  $P < 0.01$ ;  $\Delta P_{et}CO_2$ : 3.1 vs 3.2 kPa,  $P < 0.05$ ). The heart rate was lower during AFI than A (66 vs 78 bpm,  $P < 0.01$ ), reflecting an augmented diving response during AFI. The maximum safe breath-hold time under the conditions of the present study was calculated to be 101 and 106 s for A and AFI, respectively, consistent with the dynamic apnea times achieved by world-class apnea divers. It is concluded that the augmented diving response during face immersion apneas is associated with a slower reduction of the pulmonary (and arterial) oxygen store, probably delaying the occurrence of a hypoxic syncope.

Publication Types: Comparative Study  
PMID: 18298614

52: Neurol Clin. 2008 Feb;26(1):297-308; xii. Republished in: Phys Med Rehabil Clin N Am. 2009 Feb;20(1):263-72, xi. Neurologic injuries from scuba diving.

Hawes J, Massey EW. Duke University Medical Center, Box 3909, Durham, NC 27710, USA. Interest in scuba (self-contained underwater breathing apparatus) diving increased in the 1970s, and undersea diving continues to be a popular sport early in the 21st century, with approximately 3 million certified divers in the United States. The Divers Alert Network (DAN), an institution created in 1981 by the Commerce Department, National Oceanic and Atmospheric Administration, has collected diving injury data for US and Canadian divers since 1987 that can be studied to suggest the epidemiologic characteristics of diving. This article examines neurologic injuries resulting from scuba diving.

Publication Types: Case Reports  
PMID: 18295097

53: Occup Med (Lond). 2008 Mar;58(2):144-6. Epub 2008 Feb 1. Atrial fibrillation in a commercial diver.

Taimur Z, Hussaini S. Dubai Petroleum-Occupational Health, Dubai 2222, United Arab Emirates. zarqa.s.taimur@dubaipetroleum.ae BACKGROUND: The torpedo ray is a fish with powerful electric organs, which can serve either as predatory tool or defensive weapon. The name comes from the Latin 'torpere', to be stiffened or paralysed, referring to the effect on someone who handles or steps on a living electric ray. AIM: To present an unusual case of atrial fibrillation due to electric shocks by the torpedo ray (electric ray). RESULTS: A 42-year-old male commercial diver presented with atrial fibrillation after receiving repeated electric shocks from a torpedo ray while on routine diving operations. Such occurrences are extremely rare and we could find no documented case in the medical literature. CONCLUSIONS: Electric current can damage the body by disrupting electric rhythms, inducing muscular spasms and burns. In this case, we report atrial fibrillation in a diver exposed to repeated electric shocks from a torpedo ray.

Publication Types: Case Reports  
PMID: 18245786

54: Aviat Space Environ Med. 2008 Jan;79(1):67; author reply 67.  
Comment on: Aviat Space Environ Med. 2007 Apr;78(4):414-9.  
"Decompression sickness".  
Abramovich A, Shlush L.  
Publication Types: Comment Letter  
PMID: 18225783

55: Aviat Space Environ Med. 2008 Jan;79(1):44-6.  
Dysbaric osteonecrosis screening in Turkish Navy divers.  
Uzun G, Toklu AS, Yildiz S, Sonmez G, Aktaş S, Sezer H, Mutlu H, Cimşit M.  
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INTRODUCTION: Dysbaric osteonecrosis (DON) is regarded as an occupational disease for caisson workers, commercial, and military divers. Magnetic resonance imaging (MRI) was suggested for the surveillance of military divers for DON. This study aimed to determine the prevalence of DON in Turkish Navy divers. METHODS: The shoulder, hip, and knee joints of 106 male divers were screened for DON with MRI. A questionnaire was used to obtain information about subjects' medical history and diving experience. RESULTS: The mean age of divers was 34.3 +/- 5.8 yr. The divers had spent an average of 12.1 +/- 6.1 yr at their occupation. The average of total hours of diving was 834 +/- 458 h. The maximum diving depth was 53.0 +/- 18.4 m (175 +/- 61 ft) and the average diving depth was 13.3 +/- 8.4 m (44 +/- 28 ft). MRI examinations of divers did not reveal bone lesions consistent with osteonecrosis. DISCUSSION: We concluded that the risk of DON is very low for military divers who strictly obey the decompression rules and who undergo periodic medical examination. The use of MRI for routine screening of military divers is not justified.  
PMID: 18225777

56: J Appl Physiol. 2008 Apr;104(4):986-90. Epub 2008 Jan 24.  
Pulmonary edema after competitive breath-hold diving.  
Linér MH, Andersson JP.

Heart and Lung Center, EB15, Lund Univ. Hospital, SE-221 85 Lund, Sweden. Mats.Liner@med.lu.se  
During an international breath-hold diving competition, 19 of the participating divers volunteered for the present study, aimed at elucidating possible symptoms and signs of pulmonary edema after deep dives. Measurements included dynamic spirometry and pulse oximetry, and chest auscultation was performed on those with the most severe symptoms. After deep dives (25-75 m), 12 of the divers had signs of pulmonary edema. None had any symptoms or signs after shallow pool dives. For the whole group of 19 divers, average reductions in forced vital capacity (FVC) and forced expiratory volume in the first second (FEV(1)) were -9 and -12%, respectively, after deep dives compared with after pool dives. In addition, the average reduction in arterial oxygen saturation (Sa(O(2))) was -4% after the deep dives. In six divers, respiratory symptoms (including dyspnea, cough, fatigue, substernal chest pain or discomfort, and hemoptysis) were associated with aggravated deteriorations in the physiological variables (FVC: -16%; FEV(1): -27%; Sa(O(2)): -11%). This is the first study showing reduced spirometric performance and arterial hypoxemia as consequences of deep breath-hold diving, and we suggest that the observed changes are caused by diving-induced pulmonary edema. From the results of the present study, it must be concluded that the great depths reached by these elite apnea divers are associated with a risk of pulmonary edema.  
PMID: 18218906

57: J Anim Ecol. 2008 Mar;77(2):236-46. Epub 2008 Jan 21.  
Dive and beak movement patterns in leatherback turtles *Dermochelys coriacea* during internesting intervals in French Guiana.  
Fossette S, Gaspar P, Handrich Y, Le Maho Y, Georges JY.  
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1. Investigating the foraging patterns of free-ranging species is essential to estimate energy/time

budgets for assessing their real reproductive strategy. Leatherback turtles *Dermochelys coriacea* (Vandelli 1761), commonly considered as capital breeders, have been reported recently to prospect actively during the breeding season in French Guiana, Atlantic Ocean. In this study we investigate the possibility of this active behaviour being associated with foraging, by studying concurrently diving and beak movement patterns in gravid females equipped with IMASEN (Inter-Mandibular Angle SENSOR). 2. Four turtles provided data for periods varying from 7.3 to 56.1 h while exhibiting continuous short and shallow benthic dives. Beak movement ('b-m') events occurred in 34% of the dives, on average 1.8 +/- 1.4 times per dive. These b-m events lasted between 1.5 and 20 s and occurred as isolated or grouped (two to five consecutive beak movements) events in 96.0 +/- 4.0% of the recorded cases, and to a lesser extent in series (> five consecutive beak movements). 3. Most b-m events occurred during wiggles at the bottom of U- and W-shaped dives and at the beginning and end of the bottom phase of the dives. W-shaped dives were associated most frequently with beak movements (65% of such dives) and in particular with grouped beak movements. 4. Previous studies proposed wiggles to be indicator of predatory activity, U- and W-shaped dives being putative foraging dives. Beak movements recorded in leatherbacks during the first hours of their internesting interval in French Guiana may be related to feeding attempts. 5. In French Guiana, leatherbacks show different mouth-opening patterns for different dive patterns, suggesting that they forage opportunistically on occasional prey, with up to 17% of the dives appearing to be successful feeding dives. 6. This study highlights the contrasted strategies adopted by gravid leatherbacks nesting on the Pacific coasts of Costa Rica, in the deep-water Caribbean Sea and in the French Guianan shallow continental shelf, and may be related to different local prey accessibility among sites. Our results may help to explain recently reported site-

specific individual body size and population dynamics.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18217943

58: HNO. 2008 May;56(5):519-23.

[Otorhinolaryngologic disorders in association with scuba diving]  
[Article in German]

Gonnermann A, Dreyhaupt J, Praetorius M, Baumann I, Plinkert PK, Klingmann C.  
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BACKGROUND: Due to the increasing number of scuba divers in Germany, the otorhinolaryngologist has to face rising numbers of diving-associated ENT disorders. However, data about the lifetime prevalence of these disorders are insufficient. The aim of this study was to determine the frequency of ENT disorders in scuba divers correlated with their diving history. METHODS: The study design was a non-randomized, retrospective, cross-sectional study based on questionnaires. The study population included 429 active divers attending three medical diving symposia. RESULTS: The study population consisted of highly experienced divers (mean of logged dives  $m=670.0$ ) with a high diving certification level. Otitis externa was the most frequent disorder (43.6%). Barotrauma of the sinuses (10.9%), alternobaric vertigo (9.0%) and barotrauma of the middle ear (8.7%) played an important role as well. In contrast, inner ear barotrauma and decompression illness of the inner ear were less frequent but not rare (1.7 % each). CONCLUSION: A substantial number of scuba divers suffered diving-related ENT disorders.

Publication Types: English Abstract  
PMID: 18210007

59: J Appl Physiol. 2008 Apr;104(4):912-7. Epub 2008 Jan 17.  
Comment in: J Appl Physiol. 2008 Apr;104(4):907-8.

Pulmonary edema and hemoptysis after breath-hold diving at residual volume.

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To simulate pressure effects and experience thoracic compression while breath-hold diving in a relatively safe environment, competitive breath-hold divers exhale to residual volume before diving in a swimming pool, thus compressing the chest even at depth of only 3-6 m. The study was undertaken to investigate whether such diving could cause pulmonary edema and hemoptysis. Eleven volunteer breath-hold divers who regularly dive on full exhalation performed repeated dives to 6 m during a 20-min period. The subjects were studied with dynamic spirometry, video-fiberoptic laryngoscopy, and single-breath diffusion capacity of carbon monoxide (Dl(CO)). The duration of dives with empty lungs ranged from 30 to 120 s. Postdiving forced vital capacity (FVC) was reduced from mean (SD) 6.57 +/- 0.88 to 6.23 +/- 1.02 liters (P < 0.05), and forced expiratory volume during the first second (FEV(1.0)) was reduced from 5.09 +/- 0.64 to 4.59 +/- 0.72 liters (P < 0.001) (n = 11). FEV(1.0)/FVC was 0.78 +/- 0.05 prediving and 0.74 +/- 0.05 postdiving (P < 0.001) (n = 11). All subjects reported a (reversible) change in their voice after diving, irritation, and slight congestion in the larynx. Fresh blood that originated from somewhere below the vocal cords was found by laryngoscopy in two subjects. Dl(CO)/alveolar ventilation (Va) was 1.56 +/- 0.17 mmol.kPa(-1).min(-1).l(-1) before diving. After diving, the Dl(CO)/Va increased to 1.72 +/- 0.24 (P = 0.001), but 20 min later it was indistinguishable from the pre-dive value: 1.57 +/- 0.20 (n = 11). Breath-hold diving with empty lungs to shallow depths can induce hemoptysis in healthy subjects. Edema was possibly present in the lower airways, as suggested by reduced dynamic spirometry.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18202166

60: Am Nat. 2008 Mar;171(3):305-14.

The scaling of diving time budgets: insights from an optimality approach.

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Simple scaling arguments suggest that, among air-breathing divers, dive duration should scale approximately with mass to the one-third power. Recent phylogenetic analyses appear to confirm this. The same analyses showed that duration of time spent at the surface between dives has scaling very similar to that of dive duration, with the result that the ratio of dive duration to surface pause duration is approximately mass invariant. This finding runs counter to other arguments found in the diving literature that suggest that surface pause duration should scale more positively with mass, leading to a negative scaling of the dive-pause ratio. We use a published model of optimal time allocation in the dive cycle to show that optimal decisions can predict approximate mass invariance in the dive-pause ratio, especially if metabolism scales approximately with mass to the two-thirds power (as indicated by some recent analyses) and oxygen uptake is assumed to have evolved to supply the body tissues at the required rate. However, emergent scaling rules are sensitive to input parameters, especially to the relationship between the scaling of metabolism and oxygen uptake rate at the surface. Our results illustrate the utility of an optimality approach for developing predictions and identifying key areas for empirical research on the allometry of diving behavior.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18199001

61: Bull Environ Contam Toxicol. 2008 Mar;80(3):251-4. Epub 2008 Jan 11.

Proposed method for setting standards for recreational divers diving in benzene polluted waters. From P.

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There are no recognized standards for recreational diving in benzene polluted waters. If daily absorption is limited to that absorbed from drinking 2-L of water at the recommended maximal contaminant limit concentration (9.7 microg per day), then permissible diving hours can be determined. A formula is proposed that calculates allowable monthly diving time based on dermal absorption, amount of water ingested, benzene concentrations in the water and in the sediment and the proportion of the body exposed.  
PMID: 18193139

62: Exerc Sport Sci Rev. 2008  
Jan;36(1):38-42.

Beneficial role of exercise on scuba diving.

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Exercising before, during, or after diving is proscribed because of the assumption that it would increase incidence of decompression sickness. Our findings show that exercise performed in a timely fashion before diving or during decompression will reduce the number of venous gas bubbles formed. Exercise after diving did not increase the number of bubbles. Nitric oxide seems to play a protective role.  
PMID: 18156952

63: Respir Physiol Neurobiol. 2008  
Feb 29;160(3):320-4. Epub 2007 Nov 7.

Pulmonary gas exchange is reduced by the cardiovascular diving response in resting humans.  
Andersson JP, Biasoletto-Tjellström G, Schagatay EK.  
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The diving response reduces the pulmonary O<sub>2</sub> uptake in exercising humans, but it has been debated whether this effect is present at rest. Therefore, respiratory and cardiovascular responses were recorded in 16 resting subjects,

performing apnea in air and apnea with face immersion in cold water (10 degrees C). Duration of apneas were predetermined to be identical in both conditions (average: 145 s) and based on individual maximal capacity (average: 184 s). Compared to apnea in air, an augmented diving response was elicited by apnea with face immersion. The O<sub>2</sub> uptake from the lungs was reduced compared to the resting eupneic control (4.6 ml min<sup>-1</sup>kg<sup>-1</sup>), during apnea in air (3.6 ml min<sup>-1</sup>kg<sup>-1</sup>) and even more so during apnea with face immersion (3.4 ml min<sup>-1</sup>kg<sup>-1</sup>). We conclude that the cardiovascular adjustments of the diving response reduces pulmonary gas exchange in resting humans, allowing longer apneas by preserving the lungs' O<sub>2</sub> store for use by vital organs.

Publication Types: Controlled  
Clinical Trial Research Support,  
Non-U.S. Gov't  
PMID: 18088568

64: Adv Exp Med Biol. 2008;605:287-92.

Control of ventilation in diving birds.

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Studies on diving ducks indicate that the carotid bodies affect dive duration when the birds are hypoxic before a dive but not when they are hypercapnic. When close to their critical concentrations (beyond which the ducks will not dive), both oxygen and carbon dioxide reduce dive duration but hypercapnia has a much larger influence than hypoxia on surface duration. Also, excessive removal of carbon dioxide before a dive may be as important a factor in preparing for that dive as the replacement of the oxygen used during the previous dive. This observation is compatible with a physiological model of the control of diving behaviour in the Weddell seal which emphasises the significance of the level of carbon dioxide in the blood perfusing the brain.  
PMID: 18085287

65: J Exp Biol. 2008 Jan;211(Pt 1):58-65.

A new method to quantify prey acquisition in diving seabirds using wing stroke frequency.

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To understand the foraging strategies of free-ranging diving animals, time series information on both foraging effort and foraging success is essential. Theory suggests that wing stroke frequency for aerial flight should be higher in heavier birds. Based on this premise, we developed a new methodology using animal-borne accelerometers to estimate fine-scale temporal changes in body mass of a pursuit-diving, piscivorous seabird, the European shag, *Phalacrocorax aristotelis*. We hypothesized that variations in body mass determined from changes in wing stroke frequency before and after a series of dives would be related to the amount of prey captured. The estimated net gain in body mass during a foraging trip was highly variable, ranging from -30 to 260 g, values that were extremely similar to food loads obtained from shags on the Isle of May in previous years using water-offloading and nest balances. Load sizes estimated using the wing stroke method were strongly and positively related to both cumulative flight time and return flight time. At the trip level, load size was unrelated to cumulative dive bout duration and the total amount of time spent underwater. However, highly significant relationships were apparent at the individual bout level, with birds showing bigger mass gains following longer dive bouts. Results from this study are therefore extremely encouraging and suggest that changes in body mass determined from changes in wing stroke frequency may provide a reliable method of obtaining short- to medium-term information on foraging effort and success of diving seabirds.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18083733

66: HNO. 2008 May;56(5):493-8.

[Diving fitness of children and adolescents. Importance for ENT doctors]

[Article in German]

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About 10% of all sport scuba divers are children and adolescents. Little is known about the particular risks and consequences of this sport on a child's health. Due to the peculiarities of childhood anatomy and physiology, certain restrictions apply to the diving fitness of children and adolescents. Before starting scuba training, the presence of particular cognitive abilities must be demonstrated and eustachian tube dysfunction must be ruled out by a specialist. Medical contra-indications to scuba diving for adults apply to children too but must be adapted. Relative risks for adults may translate to absolute contra-indications in children and adolescents. When planning dives, there should be rigorous limitations as to depth and time. Experienced adult divers must always assist with dive planning and accompany children and adolescents when scuba diving.

Publication Types: English Abstract Review  
PMID: 18066516

67: J Comp Physiol B. 2008 Mar;178(3):321-32. Epub 2007 Dec 7. Costs of diving by wing and foot propulsion in a sea duck, the white-winged scoter.

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Most birds swim underwater by either feet alone or wings alone, but some sea ducks often use both. For white-winged scoters (*Melanitta fusca*), we measured costs ( $V(O_2)$ ) of dives to 2 m with descent by feet only versus wings + feet (only feet are used at the bottom). Dive costs repaid during the recovery period after a dive bout were an important fraction (27-44%) of total dive costs, and removing costs of extraneous surface behaviors increased resolution of differences between dive types.

Scoters using wings + feet had 13% shorter descent duration, 18% faster descent speed, 31% fewer strokes/m, and 59% longer bottom duration than with feet only. The cost of time underwater for dives using wings + feet was 32-37% lower than with feet only (P = 0.09 to 0.15). When indirect methods were used to partition descent costs from costs of ascent and bottom phases, using wings + feet lowered descent cost by an estimated 34%. Thus, using wings + feet increases descent speed and lowers descent cost, leaving more time and energy for bottom foraging. For birds in cold water, the large savings may result from both biomechanical and thermoregulatory factors.

Publication Types: Comparative Study  
Research Support, Non-U.S. Gov't  
Research Support, U.S. Gov't, Non-P.H.S.  
PMID: 18064469

68: Leg Med (Tokyo). 2008 May;10(3):119-24. Epub 2007 Nov 26. Scuba-diving related deaths in Okinawa, Japan, from 1982 to 2007. Ihama Y, Miyazaki T, Fuke C, Mukai T, Ohno Y, Sato Y. Department of Legal Medicine, School of Medicine, University of the Ryukyus, 207 Uehara, Nishihara, Okinawa 903-0125, Japan. makino@med.u-ryukyu.ac.jp

We reviewed the autopsies of scuba-diving related deaths (SDRDs) that were collected from April 1982 until March 2007. In the period under consideration, a total of 40 SDRDs were registered, out of which 34 were males and 6 females. Ages ranged from 19 to 65 years, with the average of 41.5 years (SD=12.9). Divers over the age of 40 accounted for 60% of all fatalities. The major cause of death was drowning (62.5%), followed by disease (28.5%). The average age for drowning and disease-related deaths was 38.6 (SD=12.8) and 48.7 years (SD=10.1), respectively. Of the 40 fatalities, 24 were beginners who had little or no experience. In this study, we compared SDRDs in the first term, from April 1982 to March 1995, and in the second term, from April 1995 to March 2007. The average age in the first and second terms was 35.4 and 45.2 years, respectively; the average age for the second term was

10 years older than the first. Of those in the first term, 13.3%, and of those in the second term, 40.0%, died from complications arising from already existing conditions. This study revealed that the onset of diseases during diving frequently causes fatal accidents, especially for older divers.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18037330

69: J Evol Biol. 2008 Jan;21(1):324-9. Epub 2007 Nov 14.

Allometry of diving capacities: ectothermy vs. endothermy.

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Body mass positively influences diving capacities in air-breathing vertebrates and has been identified as a key determinant for the evolution of diving. Our review on the relationship between body mass and dive duration (a major parameter of dive performances) encompassed for the first time a wide diversity of air-breathing vertebrates. We included a substantial number of nonavian and nonmammalian diving species belonging to various independent lineages (sea snakes, iguana, turtles and crocodiles). Our analyses suggest that the widely accepted size dependency of dive duration applies with significantly less force in ectotherms compared with endotherms; notably we failed to detect any effect of body mass in ectotherms. We hypothesize that the absence of tight physiological links between body mass and respiratory demands documented in ectotherms blurred our ability to detect the expected correlation. Further exploration of the evolution of diving physiology may well necessitate adopting novel perspectives to encompass both ectothermic and endothermic modes.

Publication Types: Research Support, Non-U.S. Gov't  
PMID: 18005017

70: Am J Physiol Heart Circ Physiol. 2008 Jan;294(1):H449-55. Epub 2007 Nov 9.

Cardiovascular response to acute hypoxemia induced by prolonged breath holding in air.

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Prolonged breath hold (BH) represents a valid model for studying the cardiac adaptation to acute hypoxemia in humans. Cardiac magnetic resonance (CMR) allows a three-dimensional, high-resolution, noninvasive, and nonionizing anatomical and functional evaluation of the heart. The aim of the study was to assess the adaptation of the cardiovascular system to prolonged BH in air. Ten male volunteer diving athletes (age 30 +/- 6 yr) were studied during maximal BH duration with CMR. Four epochs were studied: I, rest; II and III, intermediate BH; and IV, peak BH. Oxygen saturation (So(2)), heart rate (HR), blood pressure (BP), systemic vascular resistance (VR), end-diastolic (EDV) and end-systolic volumes (ESV), stroke volume (SV), cardiac output (CO), ejection fraction (EF), maximal elastance index (EL), systolic wall thickening (SWT), and end-systolic wall stress (ESWS) of the left ventricle (LV) were measured in all four BH epochs. Average BH duration was 3.7 +/- 0.3 min. So(2) was reduced (I: 97 +/- 0.2%, range 96-98%, vs. IV: 84 +/- 2.0%, range 76-92%; P < 0.00001). BP, EDV, ESV, SV, CO, and ESWS linearly increased from epochs I to IV, whereas EF, EL, and SWT showed an opposite behavior, decreasing from resting to epoch IV (all trends are P < 0.01). During prolonged BH in air, a marked enlargement of the LV chamber occurs in healthy diving athletes. This response to acute hypoxemia allows SV, CO, and arterial pressure to be maintained despite the severe reduction in LV contractile function.

PMID: 17993602

71: J Appl Physiol. 2008 Jan;104(1):205-11. Epub 2007 Nov 8. Central chemoreflex sensitivity and sympathetic neural outflow in elite breath-hold divers.

Dujic Z, Ivancev V, Heusser K, Dzamonja G, Palada I, Valic Z, Tank J, Obad A, Bakovic D, Diedrich A, Joyner MJ, Jordan J.

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Repeated hypoxemia in obstructive sleep apnea patients increases sympathetic activity, thereby promoting arterial hypertension. Elite breath-holding divers are exposed to similar apneic episodes and hypoxemia. We hypothesized that trained divers would have increased resting sympathetic activity and blood pressure, as well as an excessive sympathetic nervous system response to hypercapnia. We recruited 11 experienced divers and 9 control subjects. During the diving season preceding the study, divers participated in 7.3 +/- 1.2 diving fish-catching competitions and 76.4 +/- 14.6 apnea training sessions with the last apnea 3-5 days before testing. We monitored beat-by-beat blood pressure, heart rate, femoral artery blood flow, respiration, end-tidal CO(2), and muscle sympathetic nerve activity (MSNA). After a baseline period, subjects began to rebreathe a hyperoxic gas mixture to raise end-tidal CO(2) to 60 Torr. Baseline MSNA frequency was 31 +/- 11 bursts/min in divers and 33 +/- 13 bursts/min in control subjects. Total MSNA activity was 1.8 +/- 1.5 AU/min in divers and 1.8 +/- 1.3 AU/min in control subjects. Arterial oxygen saturation did not change during rebreathing, whereas end-tidal CO(2) increased continuously. The slope of the hypercapnic ventilatory and MSNA response was similar in both groups. We conclude that repeated bouts of hypoxemia in elite, healthy breath-holding divers do not lead to sustained sympathetic activation or arterial hypertension. Repeated episodes of hypoxemia may not be sufficient to drive an increase in resting sympathetic activity in the absence of additional comorbidities.

Publication Types: Research Support, Non-U.S. Gov't

PMID: 17991789

72: Clin Neurol Neurosurg. 2008 Mar;110(3):259-61. Epub 2007 Oct 24.

Transient global amnesia after breathing hyperoxic mixtures in otherwise regular dives.

Spigno F, De Lucchi M, Migliazzi L, Cocito L.

Department of Occupational Medicine, University of Genova, Genova, Italy. The diagnosis of decompression sickness may be difficult, particularly when patients present with atypical clinical manifestations after dives going on uneventfully and with full adherence to safety parameters. The case reports involve two divers who presented with transient global amnesia (TGA) immediately after surfacing from otherwise regular dives during which they had been breathing hyperoxic mixtures (Nitrox). A wide spectrum of symptoms of neural dysfunction following hyperoxic mixtures have been reported, including cases of memory impairment related to previous generalized convulsions. After a review of the literature, however, we found no previous reports of TGA, which is very unlikely to result from an epileptic mechanism, as an adverse effect of breathing hyperoxic mixtures.

Publication Types: Case Reports  
PMID: 17920188

73: Hum Mov Sci. 2008 Feb;27(1):80-95. Epub 2007 Oct 24.

Role of arms in somersaulting from compliant surfaces: a simulation study of springboard standing dives. Cheng KB, Hubbard M.

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The role of arms in compliant-surface jumping for maximizing backward somersault rotations is studied using multi-segment models and is applied to springboard diving. The surface (springboard) is modeled by a rigid bar with a rotational spring with a hinged end and point mass at the tip. Planar four- and five-segment human models are used (with the fifth segment representing the arms) and are driven by torque actuators at the ankle, knee, hip, and shoulder. Each joint torque is the product of maximum isometric torque and three variable functions depending on

instantaneous joint angle, angular velocity, and activation level, respectively. Movement simulation starts from a balanced initial posture and ends at jump takeoff. The objective is to find joint torque activation patterns during board contact so that the number of backward rotations in flight is maximized. Kinematic differences in jumps with and without arms are mainly in smaller takeoff vertical velocity and more flexed knee and hip in the former. In both jumps, joint torque/activations are similar in their minor flexion-full extension patterns. Maximum hip torque is larger with arms but maximum knee torque is larger without arms. Except at the knee, more joint work can be done with arm swing. Total angular momentum is increased considerably by arm motion because of its remote contribution. Consequently segment remote contributions to total angular momentum are much larger in jumping with arms. Shoulder strength helps generate angular momentum only to a certain limit. If more work is used to generate horizontal velocity away from the board, the amount of total angular momentum is reduced.

PMID: 17920146

74: Acta Otolaryngol. 2008 Jan;128(1):18-21.

Pressure equilibration in the penguin middle ear.

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CONCLUSIONS: King penguins have a venous structure in the form of a corpus cavernosum (CC) in their middle ear (ME) submucosa. The CC may be viewed as a special organelle that can change ME volume for pressure equilibration during deep-sea diving it is a pressure regulating organelle (PRO). A similar CC and muscles also surround the external ear (EE) and may constrict it, isolating the tympanic membrane from the outside. A CC was previously found also in the ME of marine diving mammals and can be expected to exist in other deep diving animals, such as marine turtles. OBJECTIVES: Marine animals

require equalization of middle ear (ME) pressure when diving hundreds or thousands of meters to catch prey. We investigated what mechanism enables king penguins to protect their ME when they dive to great depths. MATERIALS AND METHODS: Biopsies and serial sections of the ME and the EE of the deep diving king penguin (*Aptenodytes patagonicus*) were examined microscopically. RESULTS: It was demonstrated that the penguin ME has an extensive network of small and large submucosal venous sinuses. This venous formation, a corpus cavernosum, can expand and potentially 'flood' the ME almost completely on diving, thus elevating ME pressure and reducing the ME space. The EE has a similar protective mechanism.  
PMID: 17851907

75: Br J Sports Med. 2008 Mar;42(3):212-6; discussion 216. Epub 2007 Sep 3.  
Effects of hyperbaric exposures on cardiac pacemakers.  
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Data on tolerance of cardiac pacemakers during diving are very scarce. The aim of this study was to test electronic and mechanical tolerances of pacemakers exposed to experimental reproductions of pressures encountered during diving. Two samples each of 20 different models of cardiac pacemakers were exposed to compression during continuous telemetric monitoring. The first sample of each model was exposed to a pressure of 60 metres of sea water (msw). Each second sample was first exposed to a pressure of 30 msw then to 60 msw hyperbaric testing, with a period of 1 month between the two tests. Electronic function and structural integrity of the cans were evaluated. No electronic dysfunction was noted. We merely observed in some devices a transient increase of the pacing rate during pressurisation. No significant deformation of the can (< or =0.2 mm) was observed after the 30 msw hyperbaric test. However, after the 60 msw test, more than half of the

devices tested were significantly and definitively deformed. These results show that tested pacemakers preserved a normal electronic function up to 60 msw but most of the tested devices demonstrated significant deformations of the pacemaker can for the hyperbaric exposure observed deeper than 30 msw. Without prejudging diving aptitude for implanted pacemaker patients, it therefore seems prudent to advise them against diving beyond 30 msw because of the potential for electronic dysfunction beyond that depth.  
Publication Types: Evaluation Studies Research Support, Non-U.S. Gov't  
PMID: 17768160 [PubMed - indexed for MEDLINE]