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

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SECONDO SEMESTRE

a cura del
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Anestesia e Rianimazione del Dipartimento di Emergenza
della Azienda Ospedaliera Universitaria di Careggi

Search **"Diving"[MAJR]** Limits: **Publication Date from 2006/07 to 2006/12**

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1: Med J Malaysia. 2006 Dec;61(5):647-50.
Development of underwater and hyperbaric medicine in Malaysia.
Rozali A, Rampal KG, Zin BM, Sherina MS, Khairuddin H, Abd Halim M, Sulaiman A.
Armed Forces Health Services Division, Malaysian Armed Forces Headquarters, Lumut.
Underwater and Hyperbaric Medicine is a treatment modality gaining recognition in Malaysia. It uses the hyperbaric oxygen therapy (HBOT) approach where patients are placed in recompression chambers and subjected to oxygen therapy under pressure. In Malaysia it was introduced as early as the 1960's by the Royal Malaysian Navy to treat their divers for decompression illness (DCI), arterial gas embolism (AGE) and barotraumas. Other sectors in the armed forces, universities and private health centres began developing this approach too in the late 1990's, for similar purposes. In 1996, Underwater and Hyperbaric Medicine began gaining its popularity when the Institute of Underwater and Hyperbaric Medicine at the Armed Forces Hospital in Lumut started treating specific clinical diseases such as diabetic foot ulcers, osteomyelitis, and carbon monoxide poisoning and other diseases using HBOT. This paper discusses the development of this interesting treatment modality, giving a brief historical overview to its current development, as well as provides some thought for its future development in Malaysia.
PMID: 17623973

2: Surg Neurol. 2007 Mar;67(3):283-7. Epub 2006 Nov 3.
Spinal cord decompression sickness associated with scuba diving: correlation of immediate and delayed magnetic resonance imaging findings with severity of neurologic impairment--a report on 3 cases.
Yoshiyama M, Asamoto S, Kobayashi N, Sugiyama H, Doi H, Sakagawa H, Ida M.
Yamanashi Onsen Hospital, Fuefuki, Yamanashi 406-0004, Japan. pxn15164@nifty.ne.jp
BACKGROUND: There are few reports detailing an association between immediate and delayed changes in MR imaging findings and severity of neurologic impairment in patients with spinal cord DCS. We report on the cases of 3 patients diagnosed with spinal cord DCS presenting with severe neurologic symptoms after scuba diving. CASE DESCRIPTION: Of 175 patients with DCS referred to the Tokyo Metropolitan Ebara Hospital Department of Neurosurgery, 3 were determined by MR imaging and neurologic examination to have a spinal cord injury. Hyperbaric oxygen, methylprednisolone, and rehabilitation therapies were applied to these patients. We examined whether the severity of the patients' neurologic dysfunction, classified according to Fränkel's grade, was associated with the extent of abnormal signals depicted by spinal MR imaging in these patients at the acute phase and monthly follow-up points. T2-weighted MR imaging performed within 24 hours of the onset of the patients' neurologic symptoms revealed signals of increased intensity located predominantly in the dorsolateral regions, involving spinal segments 1 through 4, and a neurologic examination upon admission revealed severe sensory and motor dysfunction (Fränkel's grade A) in all 3 patients. The abnormal signals on MR images at 1 month postinjury were markedly decreased in size as compared with those at the acute phase. However, neurologic function showed minimal or no improvement (Fränkel's grade A or B). CONCLUSION: In patients with spinal cord DCS, the improvement in MR imaging findings was not associated with improved clinical status. This discrepancy suggests that intricate pathophysiologic changes, reversible and persistent damage subsequent to initial cord injuries (ie, edematous and neurotoxic lesions), underlie the

disease and affect the clinical course.
Publication Types: Case Reports
PMID: 17320639

3: Psychol Rep. 2006 Dec;99(3):773-80.
Physical self-presentation and competitive anxiety in male master divers.
Lorimer R, Westbury T.
Napier University, Edinburgh. R.Lorimer@lboro.ac.uk
This study investigated the link between physical self-presentation and competitive anxiety in male, master-level, high-board divers (N=84, M age = 29.3 yr., SD = 14.3). Competitive trait anxiety, social physique anxiety, and physical self-presentation confidence were assessed using the Sport Anxiety Scale, Social Physique Anxiety Scale, and the Physical Self-presentation inventory. Stepwise regression analyses indicated that variance in competitive anxiety was accounted for by the physical self-presentation variables and that these variables were more strongly associated with the cognitive anxiety subscale Worry, and to a lesser extent, Somatic Anxiety. The results of this study provide support for the argument that physical self-presentation is associated with competitive anxiety in male athletes.
PMID: 17305195

4: Undersea Hyperb Med. 2006 Nov-Dec;33(6):463-7.
Alveolar gas composition before and after maximal breath-holds in competitive divers.
Lindholm P, Lundgren CE.
Center for Research and Education in Special Environments, and Department of Physiology and Biophysics, University at Buffalo (SUNY), Buffalo, NY, USA.
The urge to breathe, as stimulated by hypercapnia, is generally considered to cause a breath-hold diver to end the breath-hold, and pre-breath hold hyperventilation has been suggested to cause hypoxic loss of consciousness (LOC) due to the reduced urge to breathe. Competitors hyperventilate before "Static Apnea", yet only 10% surface with symptoms of hypoxia such as loss of motor control (LMC) or LOC. We hypothesized that the extensive hyperventilation would prevent hypercapnia even during prolonged breath-holding and we also recorded breaking-point end-tidal PO2 in humans. Nine breath-hold divers performed breath-holds of maximal duration according to their chosen "Static Apnea" procedure. They floated face down in a swimming pool (28 degrees C). The only non-standard procedure was that they exhaled into a sampling tube for end-expiratory air, before starting the breath-hold and before resuming breathing. Breath-hold duration was 284 +/- 25 (SD) seconds. End-tidal PCO2 was 18.9 +/- 2.0 mmHg before apnea and 38.3 +/- 4.7 mmHg at apnea termination. End-tidal PO2 was 131.7 +/- 2.7 mmHg before apnea and 26.9 +/- 7.5 mmHg at apnea termination. Two of the subjects showed LMC after exhaling into the sampling tube; their end-tidal PAO2 values were 19.6 and 21.0 mmHg, respectively. End-tidal CO2 was normocapnic or hypocapnic at the termination of breath-holds. These data suggest that the athletes rely primarily on the hypoxic stimuli, probably in interaction with CO2 stimuli to determine when to end breath-holds. The severity of hypoxia close to LOC was similar to that reported for acute hypobaric hypoxia in humans.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17274316

5: Undersea Hyperb Med. 2006 Nov-Dec;33(6):447-53.
Effects of respiratory muscle training on respiratory CO2 sensitivity in SCUBA divers.
Pendergast DR, Lindholm P, Wylegala J, Warkander D, Lundgren CE.
Center for Research and Education in Special Environments, School of Medicine and Biomedical Sciences, University at Buffalo, USA.
Typically, ventilation is tightly matched to CO2 production. However, in some cases CO2 is retained (SCUBA diving). One factor behind hypoventilation in divers may be low respiratory CO2 sensitivity. If this is due to inadequate respiratory muscle performance it might be remedied by respiratory muscle training (RMT). We retrospectively investigated respiratory CO2

sensitivity prior to and after RMT in several groups of SCUBA divers. CO2 sensitivity (slope of expired ventilation as a function of inspired PCO2) was measured with a rebreathing technique in 35 subjects with diving experience. RMT consisted of either isocapnic hyperventilation or intermittent vital capacity breaths (twice/minute) against spring loaded breathing valves imposing static and resistive loads generating average inspiratory pressures of approximately 40 cmH2O and expiratory pressures of approximately 47 cmH2O; RMT was performed 30 min/day, 3 or 5 days/week for 4 weeks. Based on pre-RMT CO2 sensitivity the subjects were divided into three groups: low sensitivity: < 2 l/min/mmHg PCO2, normal: 2-4 l/min/mmHg, and high sensitivity: > 4 l/min/mmHg of inspired PCO2. The normal group had a Pre-RMT CO2 sensitivity of 2.88 +/- 0.60 and a post RMT sensitivity of 2.51 +/- 0.88 l/min/mmHg (Mean +/- SD, n = 19, p = n.s). Response in low sensitivity subjects increased from 1.41 +/- 0.32 to 2.27 +/- 0.53 (n = 10, p = 0.002,) while in the high sensitivity group it decreased from 5.41 +/- 1.25 to 2.90 +/- 0.32 l/min/mmHg (n = 6, p = 0.003). These preliminary findings showed that 46% of the subjects had abnormal sensitivity, and suggest that RMT may normalize it in hypo- and hyper-ventilating divers. If the present results are verified, RMT may be an effective means of enhancing safety in CO2 retaining divers.
Publication Types: Research Support, U.S. Gov't, Non-P.H.S.
PMID: 17274314

6: Ecology. 2006 Dec;87(12):3095-108.
Linking movement, diving, and habitat to foraging success in a large marine predator.
Austin D, Bowen WD, McMillan JI, Iverson SJ.
Department of Biology, Dalhousie University, Halifax, Nova Scotia B3H 4J1, Canada. austin@biology.ucsc.edu
Establishing where and when predators forage is essential to understanding trophic interactions, yet foraging behavior remains poorly understood in large marine carnivores. We investigated the factors leading to foraging success in gray seals (Halichoerus grypus) in the Northwest Atlantic in the first study to use simultaneous deployments of satellite transmitters, time depth recorders, and stomach-temperature loggers on a free-ranging marine mammal. Thirty-two seals were each fitted with the three types of instrumentation; however, complete records from all three instruments were obtained from only 13 individuals, underscoring the difficulty of such a multi-instrument approach. Our goal was to determine the characteristics of diving, habitat, and movement that predict feeding. We linked diving behavior to foraging success at two temporal scales: trips (days) and bouts (hours) to test models of optimal diving, which indicate that feeding can be predicted by time spent at the bottom of a dive. Using an information-theoretic approach, a Generalized Linear Mixed Model with trip duration and accumulated bottom time per day best explained the number of feeding events per trip, whereas the best predictor of the number of feeding events per bout was accumulated bottom time. We then tested whether characteristics of movement were predictive of feeding. Significant predictors of the number of feeding events per trip were angular variance (i.e., path tortuosity) and distance traveled per day. Finally, we integrated measures of diving, movement, and habitat at four temporal scales to determine overall predictors of feeding. At the 3-h scale, mean bottom time and distance traveled were the most important predictors of feeding frequency, whereas at the 6-h and 24-h time scales, distance traveled alone was most important. Bathymetry was the most significant predictor of feeding at the 12-h interval, with feeding more likely to occur at deeper depths. Our findings indicate that several factors predict feeding in gray seals, but predictor variables differ across temporal scales such that environmental variation becomes important at some scales and not others. Overall, our results illustrate the value of simultaneously recording and integrating multiple types of

information to better understand the circumstances leading to foraging success.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17249234

7: Med J Malaysia. 2006 Oct;61(4):496-8.
Pulmonary overinflation syndrome in an underwater logger.
Rozali A, Sulaiman A, Zin BM, Khairuddin H, Abd-Halim M, Sherina MS.
Armed Forces Health Services, Malaysia Armed Forces.
Pulmonary overinflation syndrome (POIS) is a group of barotrauma-related diseases caused by the expansion of gas trapped in the lung, or over-pressurization of the lung with subsequent over-expansion and rupture of the alveolar air sacs. This group of disorders includes arterial gas embolism, tension pneumothorax, mediastinal emphysema, subcutaneous emphysema and rarely pneumopericardium. In the case of diving activities, POIS is rarely reported and is frequently related to unsafe diving techniques. We report a classical case of POIS in an underwater logger while cutting trees for logs in Tasik Kenyir, Terengganu. The patient, a 24-year-old worker, made a rapid free ascent to the surface after his breathing equipment malfunctioned while he was working underwater. He suffered from bilateral tension pneumothoraces, arterial gas embolism giving rise to multiple cerebral and cerebellar infarcts, mediastinal and subcutaneous emphysema as well as pneumopericardium. He was treated in a recompression chamber with hyperbaric oxygen therapy and discharged with residual weakness in his right leg.
Publication Types: Case Reports
PMID: 17243532

8: Ugeskr Laeger. 2006 Dec 18;168(51):4523.
[Diving--an extreme sport?]
[Article in Danish]
Madsen J.
Københavns Universitet, Medicinsk-fysiologisk Institut. joop@dadlnet.dk
PMID: 17228412

9: J Appl Biomech. 2006 Aug;22(3):167-76.
Parameter determination for a computer simulation model of a diver and a springboard.
Yeadon MR, Kong PW, King MA.
School of Sport and Exercise Sciences, Loughborough University, Loughborough, UK.
This study used kinematic data on springboard diving performances to estimate viscoelastic parameters of a planar model of a springboard and diver with wobbling masses in the trunk, thigh, and calf segments and spring dampers acting at the heel, ball, and toe of the foot segment. A subject-specific angle-driven eight-segment model was used with an optimization algorithm to determine viscoelastic parameter values by matching simulations to four diving performances. Using the parameters determined from the matching of a single dive in a simulation of another dive resulted in up to 31% difference between simulation and performance, indicating the danger of using too small a set of kinematic data. However, using four dives in a combined matching process to obtain a common set of parameters resulted in a mean difference of 8.6%. Because these four dives included very different rotational requirements, it is anticipated that the combined parameter set can be used with other dives from these two groups.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17215548

10: J Appl Physiol. 2007 Apr;102(4):1324-8. Epub 2006 Dec 28.
Comment in: J Appl Physiol. 2007 Apr;102(4):1301-2.
Decompression sickness in the rat following a dive on trimix: recompression therapy with oxygen vs. heliox and oxygen.
Arieli R, Svidovsky P, Abramovich A.
Israel Naval Medical Institute, POB 8040, Haifa 31080, Israel. rarieli@netvision.net.il
Trimix (a mixture of helium, nitrogen, and oxygen) has been used in deep diving to reduce the risk of high-pressure nervous syndrome during compression and the time required for decompression at the end of the dive. There is no specific recompression treatment for

decompression sickness (DCS) resulting from trimix diving. Our purpose was to validate a rat model of DCS on decompression from a trimix dive and to compare recompression treatment with oxygen and heliox (helium-oxygen). Rats were exposed to trimix in a hyperbaric chamber and tested for DCS while walking in a rotating wheel. We first established the experimental model, and then studied the effect of hyperbaric treatment on DCS: either hyperbaric oxygen (HBO) (1 h, 280 kPa oxygen) or heliox-HBO (0.5 h, 405 kPa heliox 50%-50% followed by 0.5 h, 280 kPa oxygen). Exposure to trimix was conducted at 1,110 kPa for 30 min, with a decompression rate of 100 kPa/min. Death and most DCS symptoms occurred during the 30-min period of walking. In contrast to humans, no permanent disability was found in the rats. Rats with a body mass of 100-150 g suffered no DCS. The risk of DCS in rats weighing 200-350 g increased linearly with body mass. Twenty-four hours after decompression, death rate was 40% in the control animals and zero in those treated immediately with HBO. When treatment was delayed by 5 min, death rate was 25 and 20% with HBO and heliox, respectively.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17194730

11: Aviat Space Environ Med. 2006 Dec;77(12):1224-9.
Muscle oxygen supply during cold face immersion in breath-hold divers and controls.
Valic Z, Palada I, Bakovic D, Valic M, Mardesic-Brakus S, Dujic Z.
Department of Physiology, University of Split School of Medicine, Split, Croatia.
INTRODUCTION: The human diving reflex is characterized by bradycardia, decreased cardiac output, and peripheral vasoconstriction, and has an oxygen-conserving effect both at rest and during exercise. However, the resultant time course and extent of muscle desaturation is unknown. METHODS: We used near-infrared spectroscopy to continuously measure the decrease in tissue oxygen saturation (StO2) in the calf muscle during a series of breath-holds. Subjects were seven trained divers (TD) and eight untrained controls (UC). Other measured variables included arterial blood pressure, heart rate, and arterial oxygen saturation (SaO2). Each subject performed five maximal apneas during face immersion in cold water with 2-min recovery intervals between breath-holds. RESULTS: On average, total apnea time for TD was significantly longer than for UC (772.6 +/- 40.9 s vs. 499.1 +/- 118.2 s, respectively). Further, TD had a more pronounced decrease in StO2 than UC (70.6 +/- 15.3% for TD vs. 87.9 +/- 6.1% UC for the fifth and longest apnea). When values for the two groups were compared at the mean breakpoint time for UC, there was no difference in StO2 and SaO2 remained at baseline. By contrast, at the same time point in all five apneas, UC experienced simultaneous, significantly larger reductions in SaO2 and StO2. DISCUSSION: These data indicate that TD have an attenuated diving reflex compared with UC at the same breath-hold times (the breakpoint for UC). In addition, muscle desaturation occurs earlier than arterial desaturation in both groups; the fact that this effect was less pronounced in TD suggests a training effect. This study provides further evidence for the oxygen-conserving effect of the human diving reflex in maintaining the oxygen supply of vital organs.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17183917

12: Arch Mal Coeur Vaiss. 2006 Nov;99(11):1115-9.
[The heart and underwater diving]
[Article in French]
Lafay V.
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Cardiovascular examination of a certain number of candidates for underwater diving raises justifiable questions of aptitude. An indicative list of contraindications has been proposed by the French Federation of Underwater Studies and Sports but a physiopathological basis gives a better understanding of what is

involved. During diving, the haemodynamic changes due not only to the exercise but also to cold immersion, hyperoxaemia and decompression impose the absence of any symptomatic cardiac disease. Moreover, the vasoconstriction caused by the cold and hyperoxaemia should incite great caution in both coronary and hypertensive patients. The contraindication related to betablocker therapy is controversial and the debate has not been settled in France. The danger of drowning makes underwater diving hazardous in all pathologies carrying a risk of syncope. Pacemaker patients should be carefully assessed and the depth of diving limited. Finally, the presence of right-to-left intracardiac shunts increases the risk of complications during decompressionand contraindicates underwater diving. Patent foramen ovale is a special case but no special investigation is required for its detection. The cardiologist examining candidates for underwater diving should take all these factors into consideration because, although underwater diving is a sport associated with an increased risk, each year there are more and more people, with differing degrees of aptitude, who wish to practice it.
Publication Types: English Abstract Review
PMID: 17181043

13: Tidsskr Nor Laegeforen. 2006 Dec 14;126(24):3322-3.
[Decompression sickness in Darwin's kingdom]
[Article in Norwegian]
Westin AA, Asvall J.
Institutt for sirkulasjon og bildediagnostikk, Det medisinske fakultet, Norges teknisk-naturvitenskapelige universitet, 7489 Trondheim. andreas.vestin@legemidler.no
PMID: 17170798

14: Eur J Appl Physiol. 2007 Mar;99(4):393-404. Epub 2006 Dec 13.
Respiratory muscle training improves swimming endurance in divers.
Wylegala JA, Pendergast DR, Gosselin LE, Warkander DE, Lundgren CE.
Center for Research and Education in Special Environments, State University of New York at Buffalo, Buffalo, NY, USA.

Respiratory muscles can fatigue during prolonged and maximal exercise, thus reducing performance. The respiratory system is challenged during underwater exercise due to increased hydrostatic pressure and breathing resistance. The purpose of this study was to determine if two different respiratory muscle training protocols enhance respiratory function and swimming performance in divers. Thirty male subjects (23.4 +/- 4.3 years) participated. They were randomized to a placebo (PRMT), endurance (ERMT), or resistance respiratory muscle training (RRMT) protocol. Training sessions were 30 min/day, 5 days/week, for 4 weeks. PRMT consisted of 10-s breath-holds once/minute, ERMT consisted of isocapnic hyperpnea, and RRMT consisted of a vital capacity maneuver against 50 cm H(2)O resistance every 30 s. The PRMT group had no significant changes in any measured variable. Underwater and surface endurance swim time to exhaustion significantly increased after RRMT (66%, P < 0.001; 33%, P = 0.003) and ERMT (26%, P = 0.038; 38%, P < 0.001). Breathing frequency (f (b)) during the underwater endurance swim decreased in RRMT (23%, P = 0.034) and tidal volume (V (T)) increased in both the RRMT (12%, P = 0.004) and ERMT (7%, P = 0.027) groups. Respiratory endurance increased in ERMT (216.7%) and RRMT (30.7%). Maximal inspiratory and expiratory pressures increased following RRMT (12%, P = 0.015, and 15%, P = 0.011, respectively). Results from this study indicate that respiratory muscle fatigue is a limiting factor for underwater swimming performance, and that targeted respiratory muscle training (RRMT > ERMT) improves respiratory muscle and underwater swimming performance.
Publication Types: Randomized Controlled Trial Research Support, Non-U.S. Gov't
PMID: 17165052

15: Mil Med. 2006 Nov;171(11):1071-5.
Pulmonary function in military divers: smoking habits and physical fitness training influence.
Sekulic D, Tocilj J.

Faculty of Natural Sciences, Mathematics and Education, University of Split, North Tesla 12, 21000 Split, Croatia.
Pulmonary function (PF) tests are procedures that measure the function of the lungs, revealing problems in breathing, and therefore are highly important in diving. In this article, we studied the PF in military divers and defined the differences between (A) males (n = 32) and females (n = 27), (B) male smokers and nonsmokers, and (C) female smokers and non-smokers. PF was established by measuring: the large airway variables: inspiratory-vital capacity, forced-vital capacity, 1-second forced-expiratory volume, and 1-second forced-expiratory volume:forced-vital capacity ratio; and small airway variables: peak-expiratory flow, maximal-mid-expiratory flow, and maximal-expiratory flow after 50% and 75% of exhalation, all in absolute and relative (predicted for age and stature) values. The t test showed a significant ($p < or = 0.05$) difference between smokers and nonsmokers, but only in the relative inspiratory-vital capacity. A multivariate analysis of the variance revealed significant differences between smokers and nonsmokers in large airway variables for males and females. The possible explanations regarding the metrics, the variable relationships, and the influence of physical fitness training are discussed.
PMID: 17153544

16: J Appl Physiol. 2007 Mar;102(3):831-3. Epub 2006 Nov 30.
Comment on: J Appl Physiol. 2007 Mar;102(3):841-6.
Going to extremes of lung volume.
Whittaker LA, Irvin CG.
Publication Types: Comment Editorial Research Support, N.I.H., Extramural Research Support, Non-U.S. Gov't
PMID: 17138830

17: Br J Sports Med. 2007 Jun;41(6):375-9. Epub 2006 Nov 30.
Haemodynamic changes induced by submaximal exercise before a dive and its consequences on bubble formation.
Blatteau JE, Boussuges A, Gempp E, Pontier JM, Castagna O, Robinet C, Galland FM, Bourdon L.
Département de Médecine Hyperbare, Hôpital d'Instruction des Armées Sainte-Anne, 83800 Toulon Armées, France. je.blatteau@infonie.fr
OBJECTIVES: To evaluate the effects of a submaximal exercise performed 2 h before a simulated dive on bubble formation and to observe the haemodynamic changes and their influence on bubble formation. PARTICIPANTS AND METHODS: 16 trained divers were compressed in a hyperbaric chamber to 400 kPa for 30 min and decompressed at a rate of 100 kPa/min with a 9 min stop at 130 kPa (French Navy MN90 procedure). Each diver performed two dives 3 days apart, one without exercise and one with exercise before the dive. All participants performed a 40 min constant-load submaximal and calibrated exercise, which consisted of outdoor running 2 h before the dive. Circulating bubbles were detected with a precordial Doppler at 30, 60 and 90 min after surfacing. Haemodynamic changes were evaluated with Doppler echocardiography. RESULTS: A single bout of strenuous exercise 2 h before a simulated dive significantly reduced circulating bubbles. Post-exercise hypotension (PEH) was observed after exercise with reductions in diastolic and mean blood pressure (DBP and MBP), but total peripheral resistance was unchanged. Stroke volume was reduced, whereas cardiac output was unchanged. Simulated diving caused a similar reduction in cardiac output independent of pre-dive exercise, suggesting that pre-dive exercise only changed DBP and MBP caused by reduced stroke volume. CONCLUSION: A single bout of strenuous exercise 2 h before a dive significantly reduced the number of bubbles in the right heart of divers and protected them from decompression sickness. Declining stroke volume and moderate dehydration induced by a pre-dive exercise might influence inert gas load and bubble formation.
Publication Types: Comparative Study
PMID: 17138641

18: Spinal Cord. 2007 Oct;45(10):687-9. Epub 2006 Nov 28.

Blunt cervical spine trauma as a cause of spinal cord injury and delayed cortical blindness.
McCormick MT, Robinson HK, Bone I, McLean AN, Allan DB.
Department of Neurology, Institute of Neurological Sciences, Southern General Hospital, Glasgow, Scotland, UK.
STUDY DESIGN: Case report. OBJECTIVE: To present and discuss the case of a patient who sustained a significant flexion compression injury of the cervical spine with resulting tetraplegia and development of cortical blindness. SETTING: National Spinal Injuries Unit and Institute of Neurological Sciences, Southern General Hospital, Glasgow, Scotland, UK. METHODS: Clinical and radiological follow-up of the patient. RESULTS: Cortical blindness resulted from vertebral artery dissection associated with blunt cervical spine trauma. The patient is registered blind and is ventilator dependent. CONCLUSION: The potential complications of blunt vertebral artery injury remain poorly recognised. Screening is routinely not performed. Advances in noninvasive radiological techniques may result in recognition of asymptomatic disease and the potential for therapeutic intervention.
Publication Types: Case Reports
PMID: 17130891

19: Otol Neurotol. 2006 Dec;27(8):1120-5.
Alternobaric vertigo--really a hazard?
Klingmann C, Knauth M, Praetorius M, Plinkert PK.
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OBJECTIVE: To determine the prevalence of alternobaric vertigo (AV) in sport divers and to find out whether AV led to dangerous situations underwater. Furthermore, to examine whether objective neurootologic tests are associated with the manifestation of AV. DESIGN: Retrospective cohort study. PARTICIPANTS: Sixty-three sport divers with an average diving experience of 10 years and 650 dives were questioned regarding their medical and diving history and the manifestation of vertigo during diving. METHODS: Microscopic otoscopy, tympanometry, stapedius reflexes, hearing threshold for air and bone conduction, caloric video-oculography including analysis of the slow-phase velocity of the nystagmus, acoustic brain stem responses, and magnetic resonance imaging were performed to find possible differences between divers with and without AV. RESULTS: We found 17 divers with AV (27%). There was no significant difference in all measured parameters apart from sex and history of middle ear equalization difficulty in divers with AV. Ten (59%) of 17 female divers and 7 (15%) of 46 male divers experienced AV, representing a significant sex difference ($p < 0.001$). Correlation with our divers' outpatient clinic revealed that female divers had a significantly higher incidence of middle ear equalization disorders which could be an explanation for the predominance of female divers with symptoms of AV. None of the divers reported any dangerous or life-threatening situations following AV. Whether AV leads to dangerous situations underwater remains unclear, but this hypothesis is not supported by our data. CONCLUSION: Alternobaric vertigo is a common finding in divers. In our study group, female divers had a four-time higher risk to suffer AV. Our data do not support the thesis that AV is a life-threatening condition.
PMID: 17130801

20: J Appl Physiol. 2007 Mar;102(3):841-6. Epub 2006 Nov 16.
Comment in: J Appl Physiol. 2007 Mar;102(3):831-3.
Transpulmonary pressures and lung mechanics with glossopharyngeal insufflation and exsufflation beyond normal lung volumes in competitive breath-hold divers.
Loring SH, O'Donnell CR, Butler JP, Lindholm P, Jacobson F, Ferrigno M.
Dept. of Anesthesia and Critical Care, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA 02215, USA. sloring@bidmc.harvard.edu
Throughout life, most mammals breathe between maximal and minimal lung volumes determined by

respiratory mechanics and muscle strength. In contrast, competitive breath-hold divers exceed these limits when they employ glossopharyngeal insufflation (GI) before a dive to increase lung gas volume (providing additional oxygen and intrapulmonary gas to prevent dangerous chest compression at depths recently greater than 100 m) and glossopharyngeal exsufflation (GE) during descent to draw air from compressed lungs into the pharynx for middle ear pressure equalization. To explore the mechanical effects of these maneuvers on the respiratory system, we measured lung volumes by helium dilution with spirometry and computed tomography and estimated transpulmonary pressures using an esophageal balloon after GI and GE in four competitive breath-hold divers. Maximal lung volume was increased after GI by 0.13-2.84 liters, resulting in volumes 1.5-7.9 SD above predicted values. The amount of gas in the lungs after GI increased by 0.59-4.16 liters, largely due to elevated intrapulmonary pressures of 52-109 cmH(2)O. The transpulmonary pressures increased after GI to values ranging from 43 to 80 cmH(2)O, 1.6-2.9 times the expected values at total lung capacity. After GE, lung volumes were reduced by 0.09-0.44 liters, and the corresponding transpulmonary pressures decreased to -15 to -31 cmH(2)O, suggesting closure of intrapulmonary airways. We conclude that the lungs of some healthy individuals are able to withstand repeated inflation to transpulmonary pressures far greater than those to which they would normally be exposed.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17110514

21: J Physiol. 2007 Feb 1;578(Pt 3):859-70. Epub 2006 Nov 16.
Comment in: J Physiol. 2007 Aug 15;583(Pt 1):405; author reply 407.
The effects of acute oral antioxidants on diving-induced alterations in human cardiovascular function.
Obad A, Palada I, Valic Z, Ivancev V, Baković D, Wisløff U, Brubakk AO, Dujić Z.

Department of Physiology, University of Split School of Medicine, Soltanska 2, 21000 Split, Croatia.
Diving-induced acute alterations in cardiovascular function such as arterial endothelial dysfunction, increased pulmonary artery pressure (PAP) and reduced heart function have been recently reported. We tested the effects of acute antioxidants on arterial endothelial function, PAP and heart function before and after a field dive. Vitamins C (2 g) and E (400 IU) were given to subjects 2 h before a second dive (protocol 1) and in a placebo-controlled crossover study design (protocol 2). Seven experienced divers performed open sea dives to 30 msw with standard decompression in a non-randomized protocol, and six of them participated in a randomized trial. Before and after the dives ventricular volumes and function and pulmonary and brachial artery function were assessed by ultrasound. The control dive resulted in a significant reduction in flow-mediated dilatation (FMD) and heart function with increased mean PAP. Twenty-four hours after the control dive FMD was still reduced 37% below baseline (8.1 versus 5.1%, P = 0.005), while right ventricle ejection fraction (RV-EF), left ventricle EF and endocardial fractional shortening were reduced much less (approximately 2-3%). At the same time RV end-systolic volume was increased by 9% and mean PAP by 5%. Acute antioxidants significantly attenuated only the reduction in FMD post-dive (P < 0.001), while changes in pulmonary artery and heart function were unaffected by antioxidant ingestion. These findings were confirmed by repeating the experiments in a randomized study design. FMD returned to baseline values 72 h after the dive with pre-dive placebo, whereas for most cardiovascular parameters this occurred earlier (24-48 h). Right ventricular dysfunction and increased PAP lasted longer. Acute antioxidants attenuated arterial endothelial dysfunction after diving, while reduction in heart and pulmonary artery function were unchanged. Cardiovascular changes after diving are not fully reversed up to 3 days after a dive,

suggesting longer lasting negative effects.
Publication Types: Randomized Controlled Trial Research Support, Non-U.S. Gov't
PMID: 17110413

22: Undersea Hyperb Med. 2006 Sep-Oct;33(5):321.
Comment on: Undersea Hyperb Med. 2005 Nov-Dec;32(6):421-7.
The relative safety of forward and reverse diving profiles.
Risberg J.
Publication Types: Comment Letter
PMID: 17091830

23: Undersea Hyperb Med. 2006 Sep-Oct;33(5):313-6.
Pneumomediastinum after lung packing.
Jacobson FL, Loring SH, Ferrigno M.
Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA.
Lung packing (glossopharyngeal insufflation) consists of forcing air into the lungs, using glossopharyngeal muscle contractions similar to swallowing. Breath-hold divers perform this technique after a maximal inhalation prior to diving, thus increasing initial lung volume. However, as suggested by previous authors, this breathing maneuver could theoretically lead to lung rupture. Here we report a pneumomediastinum found on chest CT scan in a diver during a physiological study, when glossopharyngeal insufflation increased the volume of gas in the lungs by 1,040 ml (over his total lung capacity); at the same time, his transpulmonary pressures increased up to 4.1 kPa. We discuss the possibility that the very high transpulmonary pressures during lung packing caused this pneumomediastinum.
Publication Types: Case Reports Research Support, Non-U.S. Gov't
PMID: 17091828

24: Aviat Space Environ Med. 2006 Nov;77(11):1153-7.
CNS oxygen toxicity in closed-circuit diving: signs and symptoms before loss of consciousness.
Arieli R, Arieli Y, Daskalovic Y, Eynan M, Abramovich A.
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INTRODUCTION: There is a dearth of information regarding CNS oxygen toxicity accidents in closed-circuit oxygen diving. The aims of the present study were to report the sensations and symptoms that accompany CNS oxygen toxicity accidents, and to evaluate whether loss of consciousness can occur without any warning signs. METHODS: We documented 36 CNS oxygen toxicity accidents in closed-circuit oxygen diving. The full accident inquiry included the first report from the diving unit, an interview of the victim and his buddy by the researchers, and an examination of the diving equipment. RESULTS: The symptoms that appeared before termination of a dive, as reported by the victim or his buddy, were as follows (in descending order of frequency): limb convulsions; hyperventilation; difficulty maintaining a steady depth; headache; and visual disturbances. The symptoms that appeared after detachment from the mouthpiece were, in descending order of frequency: headache; loss of consciousness; confusion; weakness; dizziness; and facial muscle twitching and limb convulsions. A high inspired CO2 [mean 4.2 kPa (29.9 mmHg)] was connected with loss of consciousness. No dive was terminated before at least two symptoms (mean 3.4) had been noted a minimum of 5 min before termination. DISCUSSION: Symptoms that are accepted as being related to CNS oxygen toxicity, as well as others such as headache, difficulty maintaining a steady depth, hyperventilation, weakness, and a choking sensation, were more frequent among the O2 accident victims compared with divers who did not interrupt their dives. CONCLUSION: Awareness of any unusual sensation can prevent a potentially dangerous situation from arising.
PMID: 17086769

25: J Eur Acad Dermatol Venereol. 2006 Nov;20(10):1337-8.
Dermographism secondary to trauma from a coral reef.
Wu JJ, Huang DB, Murase JE, Weinstein GD.

Publication Types: Case Reports Letter
PMID: 17062061

26: J Hand Ther. 2006 Oct-Dec;19(4):425-9.
A silicone splint to prevent diving injuries of the thumb.
Doyle C, Lastayo P, Damore E.
BONES Physical Therapy & Sports Medicine, Sonora, CA, USA. ci_doyle@yahoo.com
PMID: 17056403

27: J Exp Biol. 2006 Nov;209(Pt 21):4238-53.
Extreme diving of beaked whales.
Tyack PL, Johnson M, Soto NA, Sturlese A, Madsen PT.
Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA. ptyack@whoi.edu
Sound-and-orientation recording tags (DTAGs) were used to study 10 beaked whales of two poorly known species, Ziphius cavirostris (Zc) and Mesoplodon densirostris (Md). Acoustic behaviour in the deep foraging dives performed by both species (Zc: 28 dives by seven individuals; Md: 16 dives by three individuals) shows that they hunt by echolocation in deep water between 222 and 1885 m, attempting to capture about 30 prey/dive. This food source is so deep that the average foraging dives were deeper (Zc: 1070 m; Md: 835 m) and longer (Zc: 58 min; Md: 47 min) than reported for any other air-breathing species. A series of shallower dives, containing no indications of foraging, followed most deep foraging dives. The average interval between deep foraging dives was 63 min for Zc and 92 min for Md. This long an interval may be required for beaked whales to recover from an oxygen debt accrued in the deep foraging dives, which last about twice the estimated aerobic dive limit. Recent reports of gas emboli in beaked whales stranded during naval sonar exercises have led to the hypothesis that their deep-diving may make them especially vulnerable to decompression. Using current models of breath-hold diving, we infer that their natural diving behaviour is inconsistent with known problems of acute nitrogen supersaturation and embolism. If the assumptions of these models are correct for beaked whales, then possible decompression problems are more likely to result from an abnormal behavioural response to sonar.
Publication Types: Research Support, Non-U.S. Gov't Research Support, U.S. Gov't, Non-P.H.S.
PMID: 17050839

28: Acta Radiol. 2006 Oct;47(8):872-4.
Sphenoid sinus barotrauma with intracranial air in sella turcica after diving.
Tryggvason G, Briem B, Guomundsson O, Einarsdóttir H.
Department of Otolaryngology-Head and Neck Surgery, Landspitali University Hospital, Reykjavik, Iceland. geir.tryggvason@gmail.com
We report the case of a diver who presented with air in the sella turcica after barotrauma to the sphenoid sinus during an ascent from a dive. To our knowledge, this is the first report of intracranial air after a barotrauma to the sphenoid sinus.
Publication Types: Case Reports
PMID: 17050370

29: Aviat Space Environ Med. 2006 Oct;77(10):1068-76.
Gas nuclei, their origin, and their role in bubble formation.
Blatteau JE, Souraud JB, Gempp E, Boussuges A.
Department of Hyperbaric Medicine, Sainte-Anne Naval Hospital, Toulon Armies, France. je.blatteau@infonie.fr
Gas bubbles are the primary agent in producing the pathogenic effects of decompression sickness. Bubble formation during decompression is not simply the consequence of inert gas supersaturation. Numerous experiments indicate that bubbles originate as pre-existing gas nuclei. Radii are on the order of 1 microm or less. Heterogeneous nucleation processes are involved in generating these gas entities. Musculoskeletal activity could be the main promoter of gas nuclei from stress-assisted nucleation. The half-life and faculty for nuclei to initiate bubble formation during decompression depend on many factors. Oxygen window and surface tension are involved in resolving bubbles. Two factors have been

proposed to stabilize gas nuclei against dissolution: gas nuclei trapped in hydrophobic crevices and gas nuclei coated with surface-active molecules such as surfactants. Diffusion and surface tension could play an important role in the formation of gas nuclei crevices. However, while the concept of in vivo hydrophobic crevices remains a theoretical possibility, none have yet been identified in tissues and/or in microcapillaries. Moreover, while surfactants seem present in numerous tissues and could play a role in gas nuclei stabilization, they could also be involved in bubble elimination. The understanding of such mechanisms is of primary importance to neutralize nuclei and for modeling bubble growth. Here we present in a single document a summary of the original findings and views from authors in this field.
PMID: 17042253

30: Aviat Space Environ Med. 2006 Oct;77(10):1028-33.
CO2 detection in closed-circuit oxygen divers with and without a distracting task.
Eynan M, Tal D, Arie E, Ne'eman F, Adir Y.
Israel Naval Medical Institute, Medical Corps, Haifa, Israel. mirite@excite.com
INTRODUCTION: Elevated arterial PCO2 (hypercapnia) increases the risk of CNS oxygen toxicity when diving with enriched oxygen gas mixtures. A CO2 detection and retention test is conducted as a matter of routine at the Israel Naval Medical Institute for physiological training, and as a screening tool for divers who may be prone to suffer from CNS oxygen toxicity. This test does not include an "attention distracter", which would provide a better simulation of the true situation during actual diving. The purpose of the present study was to examine the hypothesis that the addition of cognitive tasks to the CO2 detection and retention test might alter divers' detection ability. METHODS: We assessed ventilatory and perceptual responses to variations in inspired CO2 (range 0-5.6 kPa, 0-42 mmHg) during moderate exercise, with and without the addition of cognitive tasks, in 15 Israel Navy combat divers on active duty. The first stage was the CO2 detection training session, followed by the CO2 detection test session (TEST) and the CO2 detection test session while doing cognitive tasks (COGN). The latter two sessions were performed by some of the subjects in reverse order. Results: We found that the mean (+/- SD) PICO2 at the detection threshold was significantly lower in the COGN (1.7 +/- 0.8 kPa, 12.7 +/- 6.0 mmHg) than in the TEST (2.4 +/- 0.6 kPa, 18.1 +/- 4.5 mmHg). The mean PETCO2 while inspiring 5.6 kPa (42 mmHg) CO2 was not significantly different in the two tests. CONCLUSION: We suggest that the ability to detect CO2 during a dive is not impaired, but rather improves when the diver's attention is focused on other tasks.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17042247

31: J Laryngol Otol. 2007 Apr;121(4):306-11. Epub 2006 Jul 3.
Otolaryngological requirements for recreational self-contained underwater breathing apparatus (SCUBA) diving.
Sim RJ, Youngs RP.
Department of Otolaryngology, Gloucester Royal Hospital, Gloucester, UK.
Recreational self-contained underwater breathing apparatus (SCUBA) diving continues to grow in popularity. Medical requirements to be 'fit to dive' vary throughout the world, from self-certification to a full medical examination prior to training. This review discusses the relative merits of the most commonly used guidelines for recreational SCUBA diving, with reference to common diving-related otorhinolaryngological conditions. Areas of controversy, such as fitness to dive after rhinological and otological surgery, are discussed. The authors suggest that a unified approach from the various recreational SCUBA diving organizations involved would aid in clarification for divers and physicians alike. The difficulties in achieving such a unified approach, however, should not be underestimated.
Publication Types: Review
PMID: 17040582

32: Int J Sports Med. 2007 Apr;28(4):295-9. Epub 2006 Oct 6.
Loss of motor control and/or loss of consciousness during breath-hold competitions.
Lindholm P.
Department of Physiology and Pharmacology, Section of Environmental Physiology, Karolinska Institutet, Stockholm, Sweden. peter.lindholm@ki.se
Since the first official world championships in breath-hold diving (1996), a sport has developed where the athletes compete in various disciplines of breath-hold diving. One of the rules is that the diver should surface from a dive without showing any signs of hypoxia. Depending on the severity of hypoxia, a diver may suffer disqualifying signs such as loss of consciousness (LOC) or loss of motor control (LMC), the latter including signs such as confusion, affected postural control, spasms or speech problems. Data was collected from the results of the major international competitions following AIDA guidelines (Association International pour le Dévelopment de l'Apnée) in 1998, 2001-2004. The data was analyzed for frequency of LOC and LMC during constant weight diving and during static apnea. In constant weight diving, the diver swims down (and up) as deeply as possible along a vertically suspended rope (current record 105 m). In static apnea, the diver strives for maximum duration, floating motionless face down in a pool (current record 8.58 min). A total of 601 static apnea (SA) performances and 596 constant weight dives were judged in the six competitions. On average, 10 % of SA, and 11 % of CW performances were disqualified due to signs of hypoxia. For the competitions in 2002-2004, a distinction was made in the rules between LOC and LMC; of a total number of 355 SA performances, 1.1 % resulted in LOC, while 9.6 % resulted in LMC. For CW, the number was 344 with 6.1 % LOC and 6.1 % LMC. Despite the relatively high incidence of dramatic signs, it is noteworthy that there have been no reports of fatal accidents or permanent injuries from any of the above-mentioned competitions. This descriptive paper shows a relatively high incidence of disqualifications due to signs of hypoxia in breath-hold competitions 1998-2004.
PMID: 17024640

33: Undersea Hyperb Med. 2006 Jul-Aug;33(4):291-7.
Metabolic production of carbon dioxide in simulated sea states: relevance for hyperbaric escape systems.
Tipton M, Newton P, Reilly T.
Department of Sport & Exercise Science, Institute of Biomedical & Biomolecular Sciences, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT.
Hyperbaric Escape Systems (HES) are used when saturation diving bells have to be evacuated and divers transported to safety. The aim of the present investigation was to determine the levels of metabolic CO2 production expected from the occupants of an HES in different wave states, and from this, to recommend a reasonable and safe requirement for scrubbing CO2 within an HES. The CO2 production and heart rate of 20 male subjects representing saturation divers were collected while they were seated in an HES seat, fixed to an inflatable rescue vessel. The vessel was tethered in a wave pool and longitudinal (L), perpendicular (P), and calm (C) sea conditions were reproduced. Heart rate did not differ between conditions (P=0.33) the mean (SD) heart rates (b x min(-1)) were: C: 71 (8.5); L: 74 (9); P: 75 (9).Carbon dioxide production was significantly higher (P=0.005) with the boat orientated perpendicular to the waves compared to the calm condition. The mean (plus 99% confidence interval) carbon dioxide production for each of the conditions was C = 319mL x min(-1) + (41mL x min(-1)) = maximum of 360mL x min(-1); L=374mL x min(-1) + (46mL x min(-1)) = maximum of 420mL x min(-1); P = 409mL x min(-1) + (57mL x min(-1)) = maximum of 466mL x min(-1). It is therefore recommended that a 12 person HES should be capable of scrubbing at least 8,053L of carbon dioxide in 24 hours. Thus, the current requirement for 8,415L in 24h is reasonable.
PMID: 17004416

34: Undersea Hyperb Med. 2006 Jul-Aug;33(4):271-80.
NIHSS applied to cerebral neurological dive injuries as a tool for dive injury severity stratification.
Holck P, Hunter RW.
Department of Public Health Sciences and Epidemiology, John A. Burns School of Medicine, University of Hawaii, Honolulu, HI 96822, USA.
BACKGROUND: Evaluation via National Institutes of Health Stroke Scale (NIHSS) upon presentation in hospital triage following ischemic stroke is predictive of recovery or progression to neurological deficits. Cerebral injuries sustained while diving have symptoms similar to stroke. Applying the NIHSS to dive injuries may successfully summarize neurological dive injuries, providing a standardized tool for study of dive injury data. METHODS: We retrospectively determined NIHSS scores for a diverse population of 192 divers presenting to the University of Hawaii recompression chamber from 1983-2002, both prior to initial treatment and after all treatment. Spinal and vestibular decompression sickness cases were excluded. RESULTS: The performance of the NIHSS among this diving population was similar to its performance as an accepted tool in evaluation of ischemic stroke, although results are influenced by the abundance of mild injury cases in the data set. The estimated C-statistic with NIHSS predicting no observable deficit was 0.88, and predicting post NIHSS of 0-1 was 0.85 (vs. 0.86 when applied to stroke). Sensitivity for predicting recovery (NIHSS 0-1) at discharge was 0.99 (vs. 0.97 for stroke). CONCLUSIONS: The NIHSS applied to cerebral dive injuries has adequate predictive ability and correlates with other measures of dive injuries, while providing a standardized, more graduated scale. The NIHSS may be useful as a standardized measurement for evaluation of treatment regimens and adjunctive therapy for diving injuries.
Publication Types: Evaluation Studies
PMID: 17004414

35: Undersea Hyperb Med. 2006 Jul-Aug;33(4):223-30.
Tinnitus in an active duty navy diver: A review of inner ear barotrauma, tinnitus, and its treatment.
Duplessis C, Hoffer M.
Naval Submarine Medical Research Laboratory, Groton, Connecticut 06349, USA.
This case elucidates subtle cues that must be appreciated by the examiner in diving related injuries, who may not have experience with barotrauma-mediated pathology. Inner-ear barotrauma (IEBT) does not mandate ostensible hearing loss or vertigo; tinnitus may be the sole manifestation. Symptoms may present hours or even days post-dive. A common misconception exists that there are no efficacious treatment options for IEBT short of surgery for an overt perilymphatic fistula. Treatment options are available including acute high dose steroid administration, as prescribed for acute noise-induced or idiopathic hearing loss, optimally administered within three weeks of the acute insult. Tinnitus does not necessarily constitute a chronic untreatable symptom, which the patient must learn "to live with".
Publication Types: Case Reports Review
PMID: 17004408

36: J Obstet Gynaecol. 2006 Aug;26(6):509-13.
Scuba diving and pregnancy: can we determine safe limits?
St Leger Dowse M, Gunby A, Moncad R, Fife C, Bryson P.
Diving Diseases Research Centre, Hyperbaric Medical Centre, Plymouth, UK. marguerite@mstld.co.uk
No human data, investigating the effects on the fetus of diving, have been published since 1989. We investigated any potential link between diving while pregnant and fetal abnormalities by evaluating field data from retrospective study No.1 (1990/2) and prospective study No.2 (1996/2000). Some 129 women reported 157 pregnancies over 1,465 dives. Latest gestational age reported while diving was 35 weeks. One respondent reported 92 dives during a single pregnancy, with two dives to 65 m in the 1st trimester. In study No.2 >90% of women ceased

diving in the 1st trimester, compared with 65% in the earlier study. Overall, the women did not conduct enough dives per pregnancy, therefore no significant correlation between diving and fetal abnormalities could be established. These data indicate women are increasingly observing the diving industry recommendation and refraining from diving while pregnant. Field studies are not likely to be useful, or the way forward, for future diving and pregnancy research. Differences in placental circulation between humans and other animals limit the applicability of animal research for pregnancy and diving studies. It is unlikely that the effect of scuba diving on the unborn human fetus will be established.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17000494

37: J Parasitol. 2006 Aug;92(4):867-9.
Reduced taxonomic richness of lice (Insecta: Phthiraptera) in diving birds.
Felsõ B, Rózsa L.
Zoological Institute, Faculty of Veterinary Science, Szent István University, Budapest, Rottenbiller st. 50, H-1078 Hungary. bernadett.f@freemail.hu
Avian lice occupy different habitats in the host plumage that the physical environment outside the host body may affect in several ways. Interactions between host plumage and water may be an important source of such effects. Here, we use a comparative approach to examine the effect of a host's diving behavior on the taxonomic richness of its lice. Louse genera richness was significantly lower in clades of diving birds than on their nondiving sister clades. Species richness of host and body mass did not differ significantly between these clades; thus, these factors did not bias our results. This study suggests that the hosts' diving behavior can effectively influence ectoparasite communities.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16995408

38: Otol Neurotol. 2006 Dec;27(8):1193-6.
Recurrent diving-related inner ear barotrauma.
Shupak A.
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OBJECTIVE: To present two cases of recurrent diving-related inner ear barotrauma (IEB) and to discuss the possible cause and pathogenesis of the increased inner ear vulnerability. STUDY DESIGN: Case series. SETTING: Tertiary referral center. PATIENTS: Two scuba divers suffering from repeated cochleovestibular barotrauma. INTERVENTIONS: Neurotological evaluation, perilymphatic fistulae repair, and conservative treatment. MAIN OUTCOME MEASURE: The increasing popularity of scuba diving expose the individuals involved in this sport to unique pathologies that are not common under terrestrial conditions. The otolaryngologist who is involved in the care of these patients is required to diagnose and treat diving-related ear injuries and to consider the risk for recurrent inner ear injury when diving is resumed. CONCLUSION: IEB carries a risk for permanent hearing loss and chronic vestibulopathy. We recommend complete neurotological evaluation including high-resolution CT of the temporal bones as a routine workup for IEB. The presence of a significant residual sensorineural hearing loss, evidence for noncompensated vestibular damage, and CT findings of possible enhanced cerebrospinal fluid-perilymph connection should be considered when a return to diving activity is considered.
Publication Types: Case Reports
PMID: 16983314

39: MMW Fortschr Med. 2006 Aug 17;148(33-34):61.
[It happens every summer again]
[Article in German]
Brem MH, Hennig FF, Olk A.
Abteilung für Unfallchirurgie, Friedrich-Alexander-Universität Erlangen-Nürnberg.
Publication Types: Case Reports
PMID: 16981395

40: Echocardiography. 2006 Sep;23(8):713-5.

A case of "unexplained" decompression sickness in a commercial diver.
Lee S, Kenneth Kerut E.
School of Medicine, LSU Health Sciences Center, New Orleans, Louisiana 70072, USA.
Publication Types: Case Reports
PMID: 16970728

41: Eur J Appl Physiol. 2006 Oct;98(3):270-5. Epub 2006 Sep 9.
No changes in lung function after a saturation dive to 2.5 MPa with intermittent reduction in Po2 during decompression.
Thorsen E, Segadal K, Stuhr LE, Troland K, Grønning M, Marstein S, Hope A.
Institute of Medicine, University of Bergen, Bergen, Norway. einar.thorsen@helse-bergen.no
Decompression stress and exposure to hyperoxia may cause a reduction in transfer factor of the lung for carbon monoxide and in maximal aerobic capacity after deep saturation dives. In this study lung function and exercise capacity were assessed before and after a helium-oxygen saturation dive to a pressure of 2.5 MPa where the decompression rate was reduced compared with previous deep dives, and the hyperoxic exposure was reduced by administering oxygen intermittently at pressures of 50 and 30 kPa during decompression. Eight experienced divers of median age 41 years (range 29-48) participated in the dive. The incidence of venous gas microemboli was low compared with previous deep dives. Except for one subject having treatment for decompression sickness, no changes in lung function or angiotensin converting enzyme, a marker of pulmonary endothelial cell damage, were demonstrated. The modified diving procedures with respect to decompression rate and hyperoxic exposure may have contributed to the lack of changes in lung function in this dive compared with previous deep saturation dives.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16969641

42: Res Sports Med. 2006 Jul-Sep;14(3):163-78.
Decompression sickness following breath-hold diving.
Schipke JD, Gams E, Kallweit O.
Research Group Experimental Surgery, University Hospital Duesseldorf, Germany. schipke@med.uni-duesseldorf.de
Despite convincing evidence of a relationship between breath-hold diving and decompression sickness (DCS), the causal connection is only slowly being accepted. Only the more recent textbooks have acknowledged the risks of repetitive breath-hold diving. We compare four groups of breath-hold divers: (1) Japanese and Korean amas and other divers from the Pacific area, (2) instructors at naval training facilities, (3) spear fishers, and (4) free-dive athletes. While the number of amas is likely decreasing, and Scandinavian Navy training facilities recorded only a few accidents, the number of spear fishers suffering accidents is on the rise, in particular during championships or using scooters. Finally, national and international associations (e.g., International Association of Free Drives [IAFD] or Association Internationale pour Le Developpment De L'Apnee [AIDA]) promote free-diving championships including deep diving categories such as constant weight, variable weight, and no limit. A number of free-diving athletes, training for or participating in competitions, are increasingly accident prone as the world record is presently set at a depth of 171 m. This review presents data found after searching Medline and ISI Web of Science and using appropriate Internet search engines (e.g., Google). We report some 90 cases in which DCS occurred after repetitive breath-hold dives. Even today, the risk of suffering from DCS after repetitive breath-hold diving is often not acknowledged. We strongly suggest that breath-hold divers and their advisors and physicians be made aware of the possibility of DCS and of the appropriate therapeutic measures to be taken when DCS is suspected. Because the risk of suffering from DCS increases depending on depth, bottom time, rate of ascent, and duration of surface intervals, some approaches to assess the risks are presented. Regrettably, none of these approaches is widely accepted. We

propose therefore the development of easily manageable algorithms for the prevention of those avoidable accidents.
Publication Types: Review
PMID: 16967769

43: Aviat Space Environ Med. 2006 Sep;77(9):971-3.
Neurological disorders after repetitive breath-hold diving.
Gempp E, Blatteau JE.
G.P.D. Méditerranéé. gempp@voila.fr
We report a case of transient neurological disorder compatible with cerebral decompression illness in a breath-hold diver. A large right-to-left shunt was later detected with contrast transcranial Doppler ultrasound. While the mechanism of brain damage is unclear, this observation highlights the need for breath-hold divers to avoid excessive nitrogen loading and to refrain from forceful Valsalva maneuvers that may contribute to the opening of a patent foramen ovale and lead to paradoxical cerebral embolism. Because decompression illness is a possibility, anyone who experiences unusual symptoms after breath-hold diving should seek immediate medical attention.
Publication Types: Case Reports
PMID: 16964749

44: Aviat Space Environ Med. 2006 Sep;77(9):957-62.
Automatic detection of bubbles in the subclavian vein using Doppler ultrasound signals.
Tufan K, Ademoglu A, Kurtaran E, Yildiz G, Aydin S, Egi SM.
Department of Technical Programs, Vocational School of Fatih University, Istanbul, Turkey.
INTRODUCTION: It is possible to detect venous gas bubbles by listening to the Doppler audio signals. However, a serious disadvantage of the audio evaluation is the inability of continuous monitoring and the inter-rater agreement. Several researchers have worked on the automated detection of emboli, but no current system has the required sensitivity and specificity for clinical use. METHOD: We developed software that integrated frequency filtering, processing, and detection phases of microemboli into a graphical user interface. The detection algorithm consists of a rule-based criterion with a user-defined threshold sliding in-time axis that estimates the duration of the embolic event. Subclavian Doppler audio recordings obtained from a high altitude diving expedition were analyzed using digital filtering and non-linear operator combinations of the software. The data set includes 43 embolic events in 9 recordings from 4 different subjects. RESULTS: It was determined that embolic signals are best differentiated from the background signal at the 4500-8000-Hz frequency band. By using the non-linear "Teager Energy Operator", embolic signals were amplified against their background and a high level of sensitivity and specificity was obtained (83.7% and 97.3%, respectively). The duration of the detected emboli was estimated as 12.17 +/- 4.36 ms (mean +/- SD). DISCUSSION: The optimal frequency band for the detection of subclavian emboli is significantly higher than previous findings for the transcranial site. The duration output of the software can be used to estimate the size and the composition of emboli. Successful integration of the software into an ambulatory detection system may provide important site-specific bubble size distribution data for decompression modeling.
PMID: 16964747

45: Aviat Space Environ Med. 2006 Sep;77(9):905-8.
Post-dive bubble formation in rats: effects of exercise 24 h ahead repeated 30 min before the dive.
Løset A Jr, Møllerløkken A, Berge V, Wisløff U, Brubakk AO.
Department of Circulation and Medical Imaging, Faculty of Medicine, Trondheim, Norway.
INTRODUCTION: Recent studies have shown that a nitric oxide releasing agent or a single bout of high-intensity exercise 20-24 h before a dive can prevent bubble formation following decompression. The aim of this study was to determine whether high-intensity exercise immediately prior to a dive eliminates the protective effect of a single bout of high-intensity exercise 24 h before the dive. METHODS: Twelve female Sprague-Dawley rats were randomly divided into two equal

groups. Group 1 performed 90 min of exercise twice, beginning 24.5 h and again 2.0 h before compression. Group 2 performed 90 min of exercise beginning at 25.5 h before compression. The standardized exercise protocol was 7 x 8 min at 85-90% maximal oxygen uptake (Vo2max) followed by 2 min at 50% Vo2max for a total of 90 min including a 20 min warm-up at 40-50% of Vo2max. All rats were exposed to a pressure of 700 kPa (7 ATA) for 45 min in a dry hyperbaric chamber followed by decompression to the surface at 100 kPa (1 ATA) at a rate of 50 kPa x min(-1) (0.5 atm x min(-1)) breathing air. RESULTS: Bubble formation was significantly higher in rats that had exercised 24 h and 30 min prior to dive than rats that had only exercised 24 h prior to the dive (median bubble grade 4.5 vs. 0.5). CONCLUSION: This study demonstrated that acute exercise prior to a dive eliminated the protection against bubble formation found 24 h after high-intensity exercise in rats.
PMID: 16964738

46: Scand J Work Environ Health. 2006 Aug;32(4):310-7.
Objective neuropsychological test performance of professional divers reporting a subjective complaint of "forgetfulness or loss of concentration".
Taylor CL, Macdiarmid JI, Ross JA, Osman LM, Watt SJ, Adie W, Crawford JR, Lawson A.
Department of Environmental & Occupational Medicine, University of Aberdeen, United Kingdom.
OBJECTIVE: This study attempted to determine whether the higher prevalence of reported "forgetfulness or loss of concentration" among professional divers can be confirmed using objective neuropsychological tests. Secondary aims were to qualify the functional nature of the complaints and to ascertain whether reduced performance was linked to diving history. METHODS: In a case-control study, the neuropsychological test performance of divers complaining of moderate or severe "forgetfulness or loss of concentration" was compared with two age-matched control groups reporting no or slight "forgetfulness or loss of concentration" ("nonforgetful" divers and "nonforgetful" nondivers). The group differences were analyzed using a multivariate analysis of co-variance, followed by canonical discriminant function analysis. Altogether 102 divers with a complaint, 100 nonforgetful divers, and 100 nonforgetful nondivers completed the study. RESULTS: The overall neuropsychological performance differed significantly between the groups [Pillai's trace: F(24,484)=2.04, P=0.003]. Verbal memory (Logical Memory and the California Verbal Learning Test), current intelligence (Wechsler Abbreviated Scale of Intelligence), and sustained attention (rapid visual processing) were poorer among the divers with a complaint than among the nonforgetful divers or the nonforgetful nondivers. The tests of memory, but not those of executive function, differentiated the divers with complaints from the two control groups. Mixed gas bounce diving and surface oxygen decompression diving, but not other techniques, were negatively associated with memory performance. CONCLUSIONS: A cognitive complaint of divers was confirmed using objective tests of neuropsychological performance. Memory, rather than executive function, was affected at the group level, but only to a mild degree. The relationships between diving experience and neuropsychological test performance were small and only seen with diving techniques used in the offshore oil and gas industry.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16932829

47: Orthopedics. 2006 Aug;29(8):693-4.
Olecranon stress fracture in a young tower-diving swimmer.
Shinozaki T, Kondo T, Takagishi K.
Department of Orthopedic Surgery, Gunma Graduate University School of Medicine, Gunma, Japan.
Publication Types: Case Reports
PMID: 16924862

48: J Exp Biol. 2006 Sep;209(Pt 17):3269-80.
Body density affects stroke patterns in Baikal seals.

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Buoyancy is one of the primary external forces acting on air-breathing divers and it can affect their swimming energetics. Because the body composition of marine mammals (i.e. the relative amounts of lower-density lipid and higher-density lean tissue) varies individually and seasonally, their buoyancy also fluctuates widely, and individuals would be expected to adjust their stroke patterns during dives accordingly. To test this prediction, we attached acceleration data loggers to four free-ranging Baikal seals Phoca sibirica in Lake Baikal and monitored flipper stroking activity as well as swimming speed, depth and inclination of the body axis (pitch). In addition to the logger, one seal (Individual 4) was equipped with a lead weight that was jettisoned after a predetermined time period so that we had a set of observations on the same individual with different body densities. These four data sets revealed the general diving patterns of Baikal seals and also provided direct insights into the influence of buoyancy on these patterns. Seals repeatedly performed dives of a mean duration of 7.0 min (max. 15.4 min), interrupted by a mean surface duration of 1.2 min. Dive depths were 66 m on average, but varied substantially, with a maximum depth of 324 m. The seals showed different stroke patterns among individuals; some seals stroked at lower rates during descent than ascent, while the others had higher stroke rates during descent than ascent. When the lead weight was detached from Individual 4, the seal increased its stroke rate in descent by shifting swimming mode from prolonged glides to more stroke-and-glide swimming, and decreased its stroke rate in ascent by shifting from continuous stroking to stroke-and-glide swimming. We conclude that seals adopt different stroke patterns according to their individual buoyancies. We also demonstrate that the terminal speed reached by Individual 4 during prolonged glide in descent depended on its total buoyancy and pitch, with higher speeds reached in the weighted condition and at steeper pitch. A simple physical model allowed us to estimate the body density of the seal from the speed and pitch (1,027-1,046 kg m(-3), roughly corresponding to 32-41% lipid content, for the weighted condition; 1,014-1,022 kg m(-3), 43-47% lipid content, for the unweighted condition).
Publication Types: Comparative Study Research Support, Non-U.S. Gov't
PMID: 16916962

49: BMC Public Health. 2006 Aug 16;6:210.
Water incident related hospital activity across England between 1997/8 and 2003/4: a retrospective descriptive study.
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BACKGROUND: No one has ever reported or investigated the number of people who have been admitted to hospital for a water related incident. The purpose of this paper is to examine, the hospital activity resulting from such incidents including to length of stay, gender, age and cause. METHODS: The data was extracted from the Hospital Episode Statistics (HES) for episodes with a mention of ICD 10 (V90-94, W15-16, W65-74, X38, X92, Y21) for the years 1997/8 to 2003/4. Population based rates and relative risk were calculated using the most recent Census data for England (2001). RESULTS: The 6,793 episodes resulted in a total of 32,520 bed days with an average of length of stay of 5.0 days. Males made up 73.7% (n = 5,006) of episodes and females 26.1% (n = 1,787). Annual trends peaked in 1999-2000 at a rate of 2.4 per 100,000 and have fluctuated on alternate years there after. In terms of relative risk males are at a 2.3 to 3.0 increased annual risk of being admitted compared to females, relating to a water event. The highest annual rates were observed within the 0 - 14 age group, ranging from 3.1 to 4.2

episodes per 100,000. CONCLUSION: Based on these findings, for every one drowning that occurs per year there are three hospital episodes. Each of the age groups identified within the study reported an increase in hospital episodes between 2002 - 2003 and 2003 - 2004, when considering the fatality information available it would appear that although fatalities are decreasing in the similar time period, hospital episodes are increasing. For the 0-14 age group, the cause of the injury had changed over the years, moving away from bath tub and swimming pool, to watercraft incidents (V91 - 93). For the 15 - 59 age group there had been a decline in the frequency of watercraft and water transport episodes, however, an increase in diving and jumping injury and incidents. In the over 60 age group water transport episodes remained the most frequent, with swimming pool related episodes declining and other specified drowning and submersion increasing. More work needs to be undertaken in regard to who is admitted to hospital, when where, and how to fill gaps in knowledge and highlight information that is critical to prevention strategies.
PMID: 16914049

50: Cleve Clin J Med. 2006 Aug;73(8):711-2, 714, 716 passim.
Scuba diving: What you and your patients need to know.
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Self-contained underwater breathing apparatus (SCUBA) diving continues to gain popularity. General practitioners need to know the health requirements and contraindications so they can counsel patients appropriately. SCUBA diving injuries may not be apparent immediately and require knowledge and understanding for accurate diagnosis and treatment.
Publication Types: Review
PMID: 16913196

51: J Interv Card Electrophysiol. 2006 Apr;15(3):179-83. Epub 2006 Aug 10.
Activity-based rate-adaptive pacemakers under hyperbaric conditions.
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OBJECTIVES: The aim of this study was to test a variety of currently available activity-based rate-adaptive pacemakers under hyperbaric conditions. BACKGROUND: Sports divers with pacemakers can dive under certain circumstances. The rate response of activity-sensing pacing under hyperbaric conditions has rarely been evaluated. MATERIALS AND METHODS: We manufactured a miniaturized hyperbaric chamber. A pacemaker inside was kept close to the corresponding telemetry wand placed on top of the chamber. An inflation device for coronary balloon angioplasty was used to create hydraulic pressure. Group I pacemakers were exposed to a 30 msw/98 fsw/4 ATA and after a 1-month waiting period to 60 msw/197 fsw-depth/7 ATA. Group II was exposed to only one dive to 60 msw. The electrogram and event marker telemetry were used to monitor the pacing stimuli and measurements were made for case distortion. RESULTS: The baseline pacing rate did not change in 27 tests. Return to baseline was shown during 18 tests after transient sensor-driven rate. There was a sensor rate response to manual brief shaking during and following testing. A case distortion was shown in 15 of 29 tests at 60 m. CONCLUSIONS: Modern accelerometers showed no sensitivity to pressure on the pacemaker can at 30 msw/98 fsw and 60 msw/197 fsw but in some devices responded to pressure changes. There was no pacing dysfunction or suppression of the sensor response despite the high incidence of case distortion at 60 msw/197 fsw. As a general rule, diving should not be allowed at depths greater than 20 msw/65 fsw.
Publication Types: Comparative Study Evaluation Studies
PMID: 16900412

52: Mil Med. 2006 Jul;171(7):606-7.
Hemoptysis and breath-holding diving.

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OBJECTIVE: We aim to present one case with hemoptysis. Pulmonary barotrauma of descent (lung squeeze) has been described in breath-hold divers when the lung volume becomes smaller than the residual volume, with the effect of increased ambient pressure. METHODS: We report one case of hemoptysis in a breath-hold diver who dove for exercise of military action. RESULTS: The patient's hemoglobin and hematocrit levels were 7.3 g/dL and 26%, respectively. The computed tomography of thorax obtained 5 hours after the diving event revealed images suggestive of hemoptysis. The diagnosis of hemoptysis was made based on the diver's history and computed tomography findings. All of the divers performed voluntary diaphragmatic contractions at the beginning of their ascent, while their mouths and noses were closed. CONCLUSION: We suggest that the negative intrathoracic pressure attributable to the forced attempt to breathe along with voluntary diaphragmatic contractions contributes to hemoptysis, since it may damage the pulmonary capillaries.
Publication Types: Case Reports
PMID: 16895125

53: Med Sci Sports Exerc. 2006 Aug;38(8):1432-5.
Exogenous nitric oxide and bubble formation in divers.
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PURPOSE: Prevention of bubble formation is a central goal in standard decompression procedures. Previously we have shown that exercise 20-24 h prior to a dive reduces bubble formation and increases survival in rats exposed to a simulated dive. Furthermore, we have demonstrated that nitric oxide (NO) may be involved in this protection; blocking the production of NO increases bubble formation while giving rats a long-lasting NO donor 20 h and immediately prior to a dive reduces bubble formation. This study determined whether a short-lasting NO donor, nitroglycerine, reduced bubble formation after standard dives and decompression in man. METHODS: A total of 16 experienced divers were randomly assigned into two groups. One group performed two dives to 30 m of seawater (msw) for 30 min breathing air, and performed exercise at an intensity corresponding to 30% of maximal oxygen uptake during the bottom time. The second group performed two simulated dives to 18 msw for 80 min breathing air in a hyperbaric chamber, and remained sedentary during the bottom period. The first dive for each diver served as the control dive, whereas the divers received 0.4 mg of nitroglycerine by oral spray 30 min before the second dive. Following the dive, gas bubbles in the pulmonary artery were recorded using ultrasound. RESULTS: The open-water dive resulted in significantly more gas bubbles than the dry dive (0.87 +/- 1.3 vs 0.12 +/- 0.23 bubbles per square centimeter). Nitroglycerine reduced bubble formation significantly in both dives from 0.87 +/- 1.3 to 0.32 +/- 0.7 in the in-water dive and from 0.12 +/- 0.23 to 0.03 +/- 0.03 bubbles per square centimeter in the chamber dive. CONCLUSION: The present study demonstrates that intake of a short-lasting NO donor reduces bubble formation following decompression after different dives.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16888456

54: Respir Physiol Neurobiol. 2006 Nov;154(1-2):268-83. Epub 2006 Aug 1.
Optimal diving behaviour and respiratory gas exchange in birds.
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This review discusses the advancements in our understanding of the physiology and behaviour of avian diving that have been

underpinned by optimal foraging theory and the testing of optimal models. To maximise their foraging efficiency during foraging periods, diving birds must balance numerous factors that are directly or indirectly related to the replenishment of the oxygen stores and the removal of excess carbon dioxide. These include (1) the time spent underwater (which diminishes the oxygen supply, increases carbon dioxide levels and may even include a build up of lactate due to anaerobic metabolism), (2) the time spent at the surface recovering from the previous dive and preparing for the next (including reloading their oxygen supply, decreasing their carbon dioxide levels and possibly also metabolising lactate) and (3) the trade-off between maximising oxygen reserves for consumption underwater by taking in more air to the respiratory system, and minimising the energy costs of positive buoyancy caused by this air, to maximise the time available underwater to forage. Due to its importance in avian diving, replenishment of the oxygen stores has become integral to models of optimal diving, which predict the time budgeting of animals foraging underwater. While many of these models have been examined qualitatively, such tests of predictive trends appear fallible and only quantifiable support affords strong evidence of their predictive value. This review describes how the quantification of certain optimal diving models, using tufted ducks, indeed demonstrates some predictive success. This suggests that replenishment of the oxygen stores and removal of excess carbon dioxide have significant influences on the duration of the surface period between dives. Nevertheless, present models are too simplistic to be robust predictors of diving behaviour for individual animals and it is proposed that they require refinement through the incorporation of other variables that also influence diving behaviour such as, perhaps, prey density and predator avoidance.
Publication Types: Research Support, Non-U.S. Gov't Review
PMID: 16884962

55: Diabetes Forecast. 2006 Aug;59(8):61-2.
Diving with diabetes. What you should know before you dive in.
Ruder K.
PMID: 16881153

56: Respir Physiol Neurobiol. 2006 Nov;154(1-2):118-38. Epub 2006 Apr 28.
The evolution of a physiological system: the pulmonary surfactant system in diving mammals.
Foot NJ, Orgeig S, Daniels CB.
Discipline of Environmental Biology, School of Earth & Environmental Sciences, University of Adelaide, Adelaide, SA 5005, Australia.
Pulmonary surfactant lines the alveolar air-water interface, varying surface tension with lung volume to increase compliance and prevent adhesion of respiratory surfaces. We examined whether the surfactant system of diving mammals exhibits adaptations for more efficient lung function during diving, to complement other respiratory adaptations. Here we review adaptations at the molecular, compositional, functional and cellular levels and during development for animals beginning life on land and progressing to an aquatic environment. Molecular adaptations to diving were examined in surfactant protein C (SP-C) from terrestrial, semi-aquatic and diving mammals using phylogenetic analyses. Diving species exhibited sites under positive selection in the polar N-terminal domain. These amino acid substitutions may lead to stronger binding of SP-C to the phospholipid film and increased adsorption to the air-liquid interface. The concentration of shorter chain phospholipid molecular species was greater and SP-B levels were lower in diving than terrestrial mammals. This may lead to a greater fluidity and explain the relatively poor surface activity of diving mammal surfactant. There were no consistent differences in cholesterol between diving and terrestrial mammals. Surfactant from newborn California sea lions was similar to that of terrestrial mammals. Secretory activity of alveolar type II epithelial cells of sea lions demonstrated an insensitivity to pressure relative

to sheep cells. The poor surface activity of diving mammal surfactant is consistent with the hypothesis that it has an anti-adhesive function that develops after the first entry into the water, with a surfactant film that is better suited to repeated collapse and respreading.
Publication Types: Research Support, Non-U.S. Gov't Review
PMID: 16877052

57: Comp Biochem Physiol A Mol Integr Physiol. 2006 Sep;145(1):1-6. Epub 2006 Jun 10.
Aerobic dive limit. What is it and is it always used appropriately?
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The original definition of aerobic dive limit (ADL) was the dive duration after which there is an increase in post-dive concentration of lactate in the blood of Weddell seals freely diving in the field. The only other species in which such measurements have been made is the emperor penguin. For all other species, aerobic dive limit has been calculated (cADL) by dividing usable oxygen stores with an estimation of the rate of oxygen consumption during diving. Unfortunately, cADL is often referred to as the aerobic dive limit, implying that it is equivalent to that determined from the measurement of post-dive blood lactate concentration. However, this is not so, as at cADL all of the usable oxygen would have been consumed, whereas Weddell seals and emperor penguins can dive for at least 2-3 times longer than their ADL. Thus, at ADL, there is still some usable oxygen remaining in the stores. It is suggested that to avoid continued confusion between these two terms, the former is called diving lactate threshold (DLT), as it is somewhat analogous to the lactate threshold in exercising terrestrial vertebrates. Possible explanations of how some species routinely dive beyond their cADL are also discussed.
Publication Types: Research Support, Non-U.S. Gov't Review
PMID: 16846744

58: Chest. 2006 Jul;130(1):238-43.
Decline of FEV1 in scuba divers.
Tetzlaff K, Theysohn J, Stahl C, Schlegel S, Koch A, Muth CM.
Medical Clinic and Polyclinic, Department of Sports Medicine, University of Tuebingen Silcherstrasse 5, 72076 Tübingen, Germany. Kay.Tetzlaff@med.uni-tuebingen.de
STUDY OBJECTIVES: Obstructive changes in lung function have been reported with cumulative scuba diving exposure. The aim of this study was to investigate the decline in FEV1 in scuba divers over time. DESIGN: Prospective controlled cohort study. SETTING: German Naval Medical Institute. PATIENTS: Four hundred sixty-eight healthy, male, military scuba divers and 122 submariners (control subjects) were entered. MEASUREMENTS AND RESULTS: Pulmonary function tests were performed in all subjects on at least three occasions with a minimum interval of 1 year between first and last measurement. The decline in FEV1 was investigated fitting a general linear model to FEV1 across time with a factorial main-effects model for slopes and intercepts with respect to the factors group, smoking status, and baseline FEV1. Mean baseline age of all subjects was 32 years (SD, 9.1), and mean body mass index was 24.7 kg/m2 (SD, 2.4). Subjects were followed up for 5 years (range, 1 to 9 years) on average. Baseline FEV1 exceeded the predicted values in both divers and nondiving control subjects. There was no significant difference in the decline of FEV1 between divers and control subjects. Over time, FEV1 declined more rapidly in smokers than in nonsmokers ($p = 0.0064$) and declined more rapidly also in subjects with a baseline FEV1 above average compared to subjects below average ($p < 0.0001$). The annual decline of FEV1 peaked in smoking divers who had a high FEV1 at baseline. CONCLUSIONS: The data indicate that scuba diving is not associated with an accelerated decline in FEV1. Combined exposure to diving and smoking contributes to the fall of FEV1; therefore, smoking cessation is advised for divers.
PMID: 16840408

59: Vision Res. 2006 Oct;46(20):3443-50. Epub 2006 Jun 27.
Visual training improves underwater vision in children.
Gislén A, Warrant EJ, Dacke M, Kröger RH.
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Children in a tribe of sea-gypsies from South-East Asia have been found to have superior underwater vision compared to European children. In this study, we show that the improved underwater vision of these Moken children is not due to better contrast sensitivity in general. We also show that European children can achieve the same underwater acuity as the Moken children. After 1 month of underwater training (11 sessions) followed by 4 months with no underwater activities, European children showed improved underwater vision and distinct bursts of pupil constriction. When tested 8 months after the last training session in an outdoor pool in bright sunlight-comparable to light environments in South-East Asia-the children had attained the same underwater acuity as the sea-gypsy children. The achieved performance can be explained by the combined effect of pupil constriction and strong accommodation.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16806388

60: J Comp Physiol B. 2006 Nov;176(8):739-47. Epub 2006 Jun 22.
The influence of body size on the diving behaviour and physiology of the bimodally respiring turtle, Elseya albagula.
Mathie NJ, Franklin CE.
School of Integrative Biology, The University of Queensland, Brisbane, QLD, 4072, Australia.
In aquatic vertebrates that acquire oxygen aerially dive duration scales positively with body mass, i.e. larger animals can dive for longer periods, however in bimodally respiring animals the relationship between dive duration and body mass is unclear. In this study we investigated the relationships between body size, aquatic respiration, and dive duration in the bimodally respiring turtle, Elseya albagula. Under normoxic conditions, dive duration was found to be independent of body mass. The dive durations of smaller turtles were equivalent to that of larger individuals despite their relatively smaller oxygen stores and higher mass specific metabolic rates. Smaller turtles were able to increase their dive duration through the use of aquatic respiration. Smaller turtles had a relatively higher cloacal bursae surface area than larger turtles, which allowed them to extract a relatively larger amount of oxygen from the water. By removing the ability to respire aquatically (hypoxic conditions), the dive duration of the smaller turtles significantly decreased restoring the normal positive relationship between body size and dive duration that is seen in other air-breathing vertebrates.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16791587

61: J Exp Biol. 2006 Jul;209(Pt 13):2576-85.
The effect of myoglobin concentration on aerobic dive limit in a Weddell seal.
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One physiological adaptation for prolonged dive duration in marine mammals is an elevated myoglobin (Mb) concentration in skeletal muscle. To determine the influence of Mb concentration on the aerobic dive limit (ADL), we modified a previously published model that simulated aerobic dives in a Weddell seal (Leptonychotes weddellii) and ran it for four Mb concentrations: 5, 27, 54 and 108 g Mb kg(-1) muscle representing 7%, 50%, 100% and 200%, respectively, of the normal Mb concentration in Weddell seal skeletal muscle. The model was run at increasing levels of muscular exertion and under postabsorptive and postprandial conditions to determine their effect on ADL. For each set of conditions, the model was also run at different levels of cardiac output (i.e. the dive response was varied) to determine

the level of convective oxygen transport that optimized the ADL. In a postabsorptive state at a routine level of muscular exertion for a diving Weddell seal, a decrease in Mb concentration to 7% of normal caused a 39% decrease in the ADL (18 min to 11 min), while doubling the Mb concentration increased the ADL by 30% (18 min to 24 min). Under postprandial conditions at a routine level of muscular exertion, doubling the Mb concentration did not increase the ADL (12 min). The convective oxygen transport needed to meet the metabolic demands (Heat Increment of Feeding, HIF) of the splanchnic organs during digestion and assimilation required a cardiac output that was not optimal for the efficient use of muscle oxygen stores. This resulted in an over perfusion of the muscles and incomplete use of myoglobin-bound oxygen. As a result, the postprandial ADL was limited by the amount of oxygen stored in the blood, and increasing the Mb concentration had no effect on the ADL. We hypothesize that myoglobin concentration is optimized for the type and duration of dives routinely made by Weddell seals, and that a further increase may not increase the ADL for most free-ranging dives.
PMID: 16788040

62: Int J Sports Med. 2006 Nov;27(11):870-4. Epub 2006 Jun 8.
Pulmonary function in children after a single scuba dive.
Lemaître F, Tourny-Chollet C, Hamidouche V, Lemouton MC.
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This study evaluated the respiratory effects of a single dive in children. Eighteen young divers and 18 controls participated in our study (age range: 9 - 13 years). Volumes and expiratory flow rates were measured 20 minutes before and 10 minutes after one air dive (3 meters, 25 minutes). Before the dive, no differences were noted regarding pulmonary parameters. Ten minutes after the dive, decreases were noted in forced expiratory volume in 1 s (FEV1) and maximal voluntary ventilation (- 8 %, - 5.3 %, respectively; $p < 0.01$), peak expiratory flow, maximal expiratory flow rates at 50 % of FVC (MEF(50 %)) and MEF(25 %), forced mid-expiratory flow rate (FEF(25 - 75 %)), and FEV1/FVC(- 5.9 %, - 14.3 %, - 21.4 %, - 4.2 %, - 3.5 %, respectively; $p < 0.05$). The respiratory pattern observed 10 minutes after a single dive to three meters indicated airway narrowing. However, no association between diving experience and lung function was obtained.
PMID: 16761220

63: Int J Sports Med. 2006 Nov;27(11):875-9. Epub 2006 May 30.
Ventilatory function in experienced recreational scuba divers: Evidence of small airways disease?
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Diving has shown long-term effects on respiratory function in trained professional divers, indicating the development of small airways disease. The results are more controversial in trained recreational divers because of the different degrees of exposure and training. The aim of this study was to investigate the effects of recreational diving on respiratory function in highly experienced divers. Volumes and expiratory flow rates were measured in 32 older recreational divers (51.6 +/- 7.4 years). The forced vital capacity (FVC) and forced expiratory volume in 1 s (FEV1) were higher (+ 4.9 % and + 6 %, respectively; $p < 0.01$) than the theoretical standards (ERS 93). These values tended to decrease more rapidly as the age advanced (age range: 43 - 73 years) ($p < 0.05$). Moreover, the mid-expiratory flows at 50 %, 25 % and 25 - 75 % of vital capacity (MEF(50 %), MEF(25 %) and MEF(25 - 75 %)) were significantly decreased. These

early signs of decrease suggest slight small airways disease in older experienced recreational divers.
PMID: 16739091

64: J Appl Physiol. 2006 Sep;101(3):866-72. Epub 2006 May 25.
Increased pulmonary vascular resistance and reduced stroke volume in association with CO2 retention and inferior vena cava dilatation.
Baković D, Eterović D, Valic Z, Saratlija-Novaković Z, Palada I, Obad A, Dujić Z.
Dept. of Physiology, University of Split School of Medicine, Soltanska 2, 21000 Split, Croatia.
Changes in cardiovascular parameters elicited during a maximal breath hold are well described. However, the impact of consecutive maximal breath holds on central hemodynamics in the postapneic period is unknown. Eight trained apnea divers and eight control subjects performed five successive maximal apneas, separated by a 2-min resting interval, with face immersion in cold water. Ultrasound examinations of inferior vena cava (IVC) and the heart were carried out at times 0, 10, 20, 40, and 60 min after the last apnea. The arterial oxygen saturation level and blood pressure, heart rate, and transcutaneous partial pressures of CO(2) and O(2) were monitored continuously. At 20 min after breath holds, IVC diameter increased (27.6 and 16.8% for apnea divers and controls, respectively). Subsequently, pulmonary vascular resistance increased and cardiac output decreased both in apnea divers (62.8 and 21.4%, respectively) and the control group (74.6 and 17.8%, respectively). Cardiac output decrements were due to reductions in stroke volumes in the presence of reduced end-diastolic ventricular volumes. Transcutaneous partial pressure of CO(2) increased in all participants during breath holding, returned to baseline between apneas, but remained slightly elevated during the postdive observation period (approximately 4.5%). Thus increased right ventricular afterload and decreased cardiac output were associated with CO(2) retention and signs of peripheralization of blood volume. These results indicate that repeated apneas may cause prolonged hemodynamic changes after resumption of normal breathing, which may suggest what happens in sleep apnea syndrome.
Publication Types: Controlled Clinical Trial Research Support, Non-U.S. Gov't
PMID: 16728515

65: Eur J Appl Physiol. 2006 Jul;97(4):478-85. Epub 2006 May 13.
A single open sea air dive increases pulmonary artery pressure and reduces right ventricular function in professional divers.
Dujić Z, Obad A, Palada I, Valic Z, Brubakk AO.
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After decompression from dives, bubbles are frequently observed in the right ventricular outflow tract and may lead to vascular damage, pulmonary arterial hypertension and right ventricular overload. No data exist on the effect of open sea diving on the pulmonary artery pressure (PAP). Eight professional divers performed an open sea air dive to 30 msw. Before and postdive a Doppler echocardiographic study was undertaken. Systolic pulmonary artery pressure (SPAP) was estimated from measurement of peak flow velocity of the tricuspid regurgitant jet; the ratio between pulmonary artery acceleration times (AccT) and right ventricular ejection time (RVET) was used as an estimate of the mean PAP. No evidence of either patent foramen ovale or intra-pulmonary shunt was found in any subject postdive after performing a Valsalva maneuver. SPAP increased from 25 +/- 3 to 33 +/- 2 mmHg and AccT/RVET ratio decreased from 0.44 +/- 0.04 to 0.3 +/- 0.02 20 min after the dive, respectively. Pulmonary vascular resistance increased from 1.2 +/- 0.1 to 1.4 +/- 0.1 Woods Units. Postdive right ventricle end-diastolic and end-systolic volumes were increased for about 19% (P = 0.001) and 33% (P = 0.001) and right ejection fraction decreased about for 6% (P = 0.001). Cardiac output decreased from 4.8 +/- 0.9 (l min(-1)) to 4.0 +/- 0.6 at 40 min postdive due to decreases

in heart rate and stroke volume. This study shows that a single open sea dive may be associated with right heart overload due to increased pressure in the pulmonary artery.
Publication Types: Comparative Study Research Support, Non-U.S. Gov't
PMID: 16708239

66: J Appl Physiol. 2006 Sep;101(3):799-801. Epub 2006 May 11.
Features of glossopharyngeal breathing in breath-hold divers.
Seccombe LM, Rogers PG, Mai N, Wong CK, Kritharides L, Jenkins CR.
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One technique employed by competitive breath-hold divers to increase diving depth is to hyperinflate the lungs with glossopharyngeal breathing (GPB). Our aim was to assess the relationship between measured volume and pressure changes due to GPB. Seven healthy male breath-hold divers, age 33 (8) [mean (SD)] years were recruited. Subjects performed baseline body plethysmography (TLC(PRE)). Plethysmography and mouth relaxation pressure were recorded immediately following a maximal GPB maneuver at total lung capacity (TLC) (TLC(GPB)) and within 5 min after the final GPB maneuver (TLC(POST)). Mean TLC increased from TLC(PRE) to TLC(GPB) by 1.95 (0.66) liters and vital capacity (VC) by 1.92 (0.56) liters ($P < 0.0001$), with no change in residual volume. There was an increase in TLC(POST) compared with TLC(PRE) of 0.16 liters (0.14) ($P < 0.02$). Mean mouth relaxation pressure at TLC(GPB) was 65 (19) cmH(2)O and was highly correlated with the percent increase in TLC ($R = 0.96$). Breath-hold divers achieve substantial increases in measured lung volumes using GPB primarily from increasing VC. Approximately one-third of the additional air was accommodated by air compression.
Publication Types: Clinical Trial
PMID: 16690794

67: Joint Bone Spine. 2006 Jul;73(4):419-23. Epub 2006 Mar 20.
Effects of breath-hold diving on bone mineral density of women divers.
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OBJECTIVES: The relationship between bone mineral density (BMD) and swimming has been thoroughly researched. The aim of this study was to determine the effects of breath-hold diving on the BMD in the proximal femurs of women divers. METHODS: A case-control observational study was carried out using health-checks of divers and control subjects at a hospital in Jeju City, South Korea. Women divers (N=61) were matched individually with non-diver controls (N=61) by age, weight, and postmenopausal year. The bone mineral densities of their proximal femurs (total hip, femoral neck) were assessed by dual-energy X-ray absorptiometry. RESULTS: The average diving year of women divers was 34+/-13 years. The BMD of divers was higher than that of controls in the total hip and femur neck area ($P<0.05$). On multiple linear regression analysis, age and body weight were predictors of proximal femur bone mineral densities in divers. On linear regression analysis of the proximal femur BMD according to age in divers and controls, the bone mineral densities of divers tend to decrease more rapidly than those of controls in all two areas of the proximal femurs. CONCLUSIONS: Our study results may suggest that diving in a high-pressure environment is an osteogenic stimulus. However, the weight-supported environment in diving exerts an effect that reduces BMD proportionately to the time spent in the water.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16626996

68: J Comp Physiol B. 2006 Aug;176(6):535-45. Epub 2006 Mar 3.
Ontogeny of total body oxygen stores and aerobic dive potential in Steller sea lions (Eumetopias jubatus).
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Two key factors influence the diving and hence foraging ability of marine mammals: increased oxygen stores prolong aerobic metabolism and decreased metabolism slows rate of fuel consumption. In young animals, foraging ability may be physiologically limited due to low total body oxygen stores and high mass specific metabolic rates. To examine the development of dive physiology in Steller sea lions, total body oxygen stores were measured in animals from 1 to 29 months of age and used to estimate aerobic dive limit (ADL). Blood oxygen stores were determined by measuring hematocrit, hemoglobin, and plasma volume, while muscle oxygen stores were determined by measuring myoglobin concentration and total muscle mass. Around 2 years of age, juveniles attained mass specific total body oxygen stores that were similar to those of adult females; however, their estimated ADL remained less than that of adults, most likely due to their smaller size and higher mass specific metabolic rates. These findings indicate that juvenile Steller sea lion oxygen stores remain immature for more than a year, and therefore may constrain dive behavior during the transition to nutritional independence.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16514541

69: Rheumatology (Oxford). 2006 Jul;45(7):855-8. Epub 2006 Jan 25.
Risk factors for dysbaric osteonecrosis.
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OBJECTIVES: Dysbaric osteonecrosis (DON) is a complication of ineffective decompression following exposure to high-pressure environments. This study was designed to determine risk factors for the occurrence of DON in divers. METHODS: Fifty-six male divers received skeletal examinations by radiography to assess the occurrence of DON. A questionnaire was used to obtain clinical and diving information, including diving experience and maximum diving depth. Blood samples were collected to analyse the levels of plasminogen activator inhibitor (PAI)-1, cholesterol, triglyceride, low-density lipoprotein, very low-density lipoprotein, high-density lipoprotein, apolipoprotein A1 and apolipoprotein B. RESULTS: Lesions of DON were detected in 31 of the 56 (55%) divers. Multivariate logistic regression analysis showed that high levels of PAI-1, a coagulation marker (odds ratio 4.281; P=0.0296) and great maximum diving depth (odds ratio 5.627; P=0.0231) were independent predictors of DON. CONCLUSIONS: This study has shown the presence of coagulation abnormality in divers with DON. This result suggests that a pharmacological approach incorporating the use of an anticoagulant may represent a potential strategy for the prevention of DON.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16436490

70: Forensic Sci Int. 2006 Dec 20;164(2-3):122-5. Epub 2006 Jan 19.
Comparison of pulmonary autopsy findings of the rats drowned at surface and 50 ft depth.
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INTRODUCTION: When a body is recovered from the water after a fatal SCUBA diving accident, it is useful to know if the diver was under pressure or not when he/she took his/her last breath, in order to determine the cause and manner of the death. If the victim was under pressure, the air remained in the lungs of the diver will be equal to the environmental pressure. If the body comes to the surface, the air in the lung will expand according to the Boyle's Gas Law and give mechanical damage to the surrounding tissues, due to decreases in environmental pressure. We designed an experimental study to see the

difference in pulmonary autopsy findings of the rats that drowned under normobaric and hyperbaric conditions. METHOD: Forty five male, 250-300 g, Sprague Downey adult rats were divided into three groups. Two groups of rats were drowned under normobaric conditions (Groups DS Group DSS) and the third group at 50 ft pressure (Group DD). The pulmonary autopsy findings of the groups were compared. In the light microscopy, the number of the microscopic fields (x10) containing at least one emphysematous area with longitudinal dimension greater than 300 micro m were compared among the groups. RESULTS: The gross examination revealed a prominent swelling of the lungs in all rats in the Group DD, in comparison to that of the Groups DS and DSS. The number of the microscopic fields, which included at least one emphysematous area with longitudinal dimension greater than 300 micro m out of 150 fields from each of the groups DS, DSS and DD, were 88, 101 and 115 respectively. The difference between the group DS and DD was found to be statistically significant. CONCLUSION: We conclude that in investigating the fatal diving accidents, pulmonary autopsy findings give valuable information whether the death occurred at the surface or at the depth.
PMID: 16427229

71: Knee Surg Sports Traumatol Arthrosc. 2006 Sep;14(9):907-14. Epub 2006 Jan 17.
Back pain and degenerative abnormalities in the spine of young elite divers: a 5-year follow-up magnetic resonance imaging study.
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Several studies have been published on disc degeneration among young athletes in sports with great demands on the back, but few on competitive divers; however, there are no long-term follow-up studies. Twenty elite divers between 10 and 21 years of age, with the highest possible national ranking, were selected at random without knowledge of previous or present back injuries or symptoms for an MRI study of the thoraco-lumbar spine in a 5-year longitudinal study. The occurrence of MRI abnormalities and their correlation with back pain were evaluated. Eighty-nine percent of the divers had a history of back pain and the median age at the first episode of back pain was 15 years. Sixty-five percent of the divers had MRI abnormalities in the thoraco-lumbar spine already at baseline. Only one diver without abnormalities at baseline had developed abnormalities at follow-up. Deterioration of any type of abnormality was found in 9 of 17 (53%) divers. Including all disc levels in all divers, the total number of abnormalities increased by 29% at follow-up, as compared to baseline. The most common abnormalities were reduced disc signal, Schmorl's nodes, and disc height reduction. Since almost all divers had previous or present back pain, a differentiated analysis of the relationship between pain and MRI findings was not possible. However, the high frequency of both back pain and MRI changes suggests a causal relationship. In conclusion, elite divers had high frequency of back pain at young ages and they run a high risk of developing degenerative abnormalities of the thoraco-lumbar spine, probably due to injuries to the spine during the growth spurt.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 16416326

72: Respir Physiol Neurobiol. 2006 Aug;153(1):66-77. Epub 2006 Jan 18.
Deep diving mammals: Dive behavior and circulatory adjustments contribute to bends avoidance.
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A mathematical model was created that predicted blood and tissue N(2) tension (P(N2)) during breath-hold diving. Measured muscle P(N2) from the bottlenose dolphin after diving repeatedly to 100 m (Tursiops truncatus [Ridgway and Howard, 1979,

Science, 4423, 1182-1183]) was compared with predictions from the model. Lung collapse was modelled as a 100% pulmonary shunt which yielded tissue P(N2) similar to those reported for the dolphin. On the other hand, predicted muscle P(N2) for an animal with a dive response, reducing cardiac output by 66% from surface values (20.5 to 6.8l x min(-1)), also agreed well with observed values in the absence of lung collapse. In fact, modelling indicated that both cardiovascular adjustments and dive behaviour are important in reducing N2 uptake during diving and enhancing safe transfer of tissue and blood N2 back to the lung immediately before coming to the surface. In particular, diving bradycardia during the descent and bottom phase together with a reduced ascent rate and increase in heart rate reduced mixed venous P(N2) upon return to the surface by as much as 45%. This has important implications as small reductions in inert gas load (approximately 5%) can substantially reduce decompression sickness (DCS) risk by as much as 50% (Fahlman et al., 2001, J. Appl. Physiol. 91, 2720-2729).

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