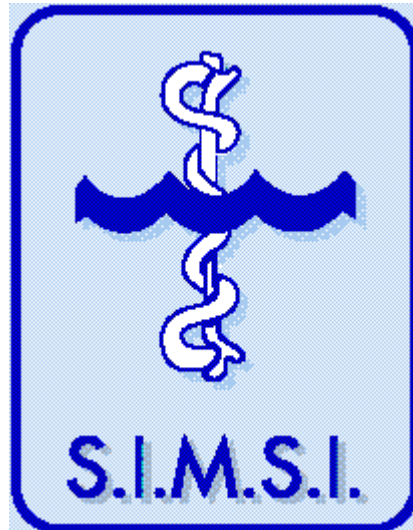
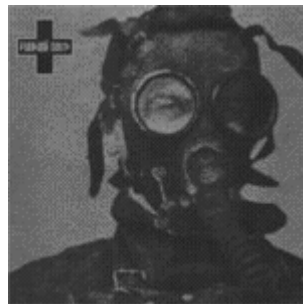


**SOCIETA' ITALIANA
DI
MEDICINA SUBACQUEA E IPERBARICA**



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



2003

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

Search "Diving"[MeSH] Limits: Publication Date from 2003 to 2003

**Search "Diving"[MeSH] Limits:
Publication Date from 2003 to 2003**

1: Rev Biol Trop. 2003 Jun;51 Suppl 4:189-95.

[Evaluation of the impact of recreational dive activity on the community structure of some coral reefs at Los Roques Archipelago National Park, Venezuela]

[Article in Spanish]

Zubillaga AL, Pauls SM, Croquer A. Laboratorio de Comunidades Marinas, Universidad Simon Bolivar, Sartenejas, Caracas, Venezuela. zubillaga@hotmail.com

In order to evaluate if snorkeling had significant effects on coral community structure, three different coral reefs (Madrizqui, Pelona de Rabusqui and Crasqui) located at Archipelago Los Roques National Park, Venezuela, were surveyed. For each site, the coral community structure of two different areas, one subjected to intense snorkeling use (FB) and other not frequently used (PFB), were compared. Community structure was determined with 1 m²-quadrants and 20 m-long transects. These communities were described in terms of species richness, diversity (Shannon-Wiener) and evenness indexes, live and dead coral cover and cover of other organisms (sponges, octocorals and algae). Comparisons within sites were performed with a Kruskal-Wallis test. A total of 24 species of scleractinian corals were found. Live coral cover ranged from 29.9% +/- 26.43 (Crasqui) to 34.55% +/- 6.43 (Madrizqui), while dead coral cover ranged from 32.51% +/- 2.86 (Madrizqui) to 60.78% +/- 21.3 (Pelona de Rabusqui). The PFB areas showed higher live coral cover compared to FB areas; however, significant differences were only found in Crasqui and Pelona de Rabusqui (p < 0.05). Species richness, diversity and evenness were variable and no trends were observed between FB and PFB areas. The frequency of both damaged and diseased colonies were low (< 1%), most damages observed were natural (parrotfish predation). Damages

caused by divers such as fin impacts, were not found at the reefs studied. These results suggest that, currently, diving pressure is not as high to cause massive loses of live coral cover in these reefs. However, the lack of strict controls for these activities might produce long-term changes in the structure of these coral communities.

PMID: 15264571 [PubMed - indexed for MEDLINE]

2: Rev Med Suisse Romande. 2003 Feb;123(2):135-7.

[Asthma and scuba diving]

[Article in French]

Heritier F, Leuenberger P. Division de Pneumologie et Soins Intensifs de Medecine (caisson hyperbare) Centre Hospitalier Universitaire Vaudois. drfheritier@bluewin.ch

In scuba diving, the density of the gases supplied increases with depth. During ascent, overinflation of the lungs is avoided by exhalation. In case of airway obstruction, the theoretical risk of pulmonary barotrauma and drowning increases. For this reason, asthma has been considered as a contraindication to scuba diving. This recommendation is often ignored and many people with asthma dive, apparently without problems. Certifying that an asthmatic patient is fit to dive remains a controversial and difficult matter. In case of mild intermittent asthma, scuba diving seems possible when the pulmonary function test is normal and the patient is asymptomatic, including during exercise and exposure to cold air. The asthmatic diver should be fully informed of the risks incurred and should notify his or her informed-consent to the physician.

Publication Types: Review
Review, Tutorial

PMID: 15095697 [PubMed - indexed for MEDLINE]

3: Encephale. 2003 Nov-Dec;29(6):488-97.

[Subjective well-being and self-regulation in risk taking behaviors. The case of scuba-diving]

[Article in French]

Bonnet A, Pardinielli JL, Romain F, Rouan G.

Laboratoire PsyCLE, EA 3273, UFR Psychologie, Universite de Provence, Aix-en-Provence.

Nowadays, risk-taking behaviors category is a very fast growing domain, yet not well known. Recent studies point out the importance of emotional phenomenons in subjective risk-taking behaviors. According to this axis, on scuba-diving empirical field, we aim to depict the size and the role of psychological process in the realization of the behavior; our research links personality variables and emotional ones. The observation of scuba-Divers behavior lead us to construct a fitting of conceptual positions to give an account of that behavior and its subjective function. The self-regulation concept has been dimensioned through several factors and the scales in respect of: Thrill and Adventure Seeking (Zuckerman, 1980), Anhedonia (Snaith-Hamilton Pleasure Scale, 1995), Subjective Well-being (Diener, 1992) and Differential Emotions (Izard, 1972). The population of this study is composed of 74 subjects. They are grouped in 2 categories depending of the risk-taking behavior, injured or injured less. The data have been statistically treated by classic methods (c2, Student t test) and logistic regression. It appears that Thrill and Adventure Seeking discriminate risk-taking in scuba-diving. The results especially support the weight of emotional variables. It turns out that risk-taking subjects are particularly sensitive to negative emotions. Negative well-being seems to be a central characteristic of the emotional functioning of these subjects. Moreover injured subjects tend to overestimate emotions linked to the behavior. Anhedonia is not a characteristic factor. So it introduces the notion of emotionality and sublines the interactions between risk-taking behavior and emotions through the self-regulation concept.

PMID: 15029083 [PubMed - indexed for MEDLINE]

4: Contact Dermatitis. 2003 Nov;49(5):267-8.

Contact dermatitis due to para-tertiary-butylphenol-formaldehyde resin in a wetsuit.

Nagashima C, Tomitaka-Yagami A, Matsunaga K.

Department of Dermatology, Fujita Health University School of Medicine, Toyoake, Aichi 470-1192, Japan. cnaga@fujita-hu.ac.jp

Publication Types: Case Reports
PMID: 14996059 [PubMed - indexed for MEDLINE]

5: G Ital Med Lav Ergon. 2003 Jul-Sep;25 Suppl(3):249-51.

[Safety and health protection of professional divers in the context of the European Diver Technology Committee (EDTC): technical training and diver competence, role of the "examining" physician]

[Article in Italian]

Giovagnoli P, Bianco P, Ragusa F, Arduino G, Anzelmo V, Castellino N. Sanita Marittima Roma Fiumicino, Ministero della Salute.

It is necessary to standardize some parameters for occupational health and safety of their professional diver: risk assessment of work duty, appropriate training program and sanitary surveillance. European Diver Technology Committee (EDCT) gathers the member State's experience about safety procedures, professionals and sanitay surveillance. EDTC criterions to whom it is possible to refer in Italy waiting specific regulations are reported.

PMID: 14979172 [PubMed - indexed for MEDLINE]

6: Int Marit Health. 2003;54(1-4):135-43.

Standards on medical fitness examinations for Navy divers.

Weiss M.

Naval Medical Institute, Kopperpahler Allee 120, D-24119 Kronshagen.

The German Navy employs approximately 480 divers in their primary and secondary role. Before entering diving training, every diver has to pass an intensive physical examination programme at the German Naval Medical Institute (NMI) in Kiel-Kronshagen. Annual follow-ups ensure the currency of the medical findings. Criteria of medical fitness for diving reflect industrial medical standards for hyperbaric workers as well as the general medical guidelines for NATO divers. A diving examination

consists of the individual medical history, a physical examination including the neurological status and the assessment of the cardiovascular fitness by ECG and bicycle ergometry. The respiratory system is screened by regular chest x-rays and spirometry or body plethysmography. Blood and urine samples are taken to look for abnormal haematological and metabolic conditions as well as disorders of the genito-urinary system. In order to determine visual fitness, diver's visual acuity, colour vision and stereopsis as well as eye fundi are examined by an eye specialist. Also the ENT examination involves a speciality consultant and consists of audiometry, inspection of the external ear and tympanic membrane and functional tests. To ensure a high standard of dental fitness, screening by a dental officer is part of the annual check-up. Every routine diving medical examination at the NMI includes a pressure test in the hyperbaric chamber. Divers who use nitrox or oxygen-rebreather devices have to pass successfully an oxygen tolerance test under hyperbaric conditions. The annual routine diving medical examination contributes to minimize the risk of accidents in military diving operations.

PMID: 14974787 [PubMed - indexed for MEDLINE]

7: Int Marit Health. 2003;54(1-4):127-34.

Change of occurrence of type 1 and type 2 decompression sickness of divers treated at the Croatian Naval Medical Institute in the period from 1967 to 2000.

Andric D, Petri NM, Stipancevic H, Petri LV, Kovacevic H.

The Naval Medical Institute, Department of Undersea and Hyperbaric Medicine, Split, Croatia. A significant change of occurrence ($p=0.0343$) of type 1 and type 2 decompression sickness (DCS) of divers in Croatia was observed in the period from 1991 to 2002 (type 1: $n=26$, 37.68% and type 2: $n=43$, 62.32%) compared with the period from 1967 to 1990 (type 1: $n=93$, 52.84% and type 2: $n=83$, 47.16%). The change was attributed to the extensive usage of diving computers

and artificial gas mixtures which enable extended bottom times and deeper dives, thus putting divers at an increased decompression risk. The importance of the results of this report is in the fact that permanent neurological deficit occurs only after type 2 DCS. Injured divers with permanent loss after type 2 DCS are not fit for diving and require a long term medical care, thus becoming a significant public health problem.

PMID: 14974786 [PubMed - indexed for MEDLINE]

8: Int Marit Health. 2003;54(1-4):117-26.

Oxidative stress during oxygen tolerance test.

Kot J, Sicko Z, Wozniak M.

National Center for Hyperbaric Medicine, Institute of Maritime and Tropical Medicine, Medical University of Gdansk, Gdynia, Poland.

Reactive oxygen species, including oxygen free radicals are normally generated in human cells during aerobic metabolism. Their production may increase during breathing of hyperoxic mixtures. The 'oxidative stress' has been postulated to be an important contributor to CNS oxygen toxicity. One of the highest partial pressure of oxygen used in healthy humans is 280 kPa(a) during 30 min of 'oxygen tolerance tests' (OTT). This test is conducted in order to detect some individuals with an increased sensitivity to high partial pressures of oxygen leading them to develop CNS oxygen toxicity earlier than others. The purpose of this study was to investigate whether the OTT (30 min of breathing pure oxygen at 280 kPa(a)) would significantly induce oxidative stress in healthy population. The first group consisted of 52 subjects, in whom total antioxidant status (TAS) was measured. The second group consisted of 44 subjects, in whom protein carbonyls (PC), total thiol (t-SH) and heat shock proteins (HSP70) were measured. All measurements were done just before and immediately after the OTT. There was no statistically significant change of TAS. We observed a small, however statistically significant increase of PC and decrease of t-SH. A

significant decrease of HSP70 was detected, however false positives of initial measurements are suspected. In summary, in young healthy subjects 30 min of breathing oxygen under pressure of 280 kPa(a) induces oxidative stress which can be detected by increase of protein carbonyls and by decrease of total thiol. In our study this stress was not reflected in measurement of total oxidative status and heat shock proteins.
PMID: 14974785 [PubMed - indexed for MEDLINE]

9: Int Marit Health. 2003;54(1-4):108-16.

The maximum tissue half-time for nitrogen elimination from divers' body.

Sicko Z, Kot J, Doboszynski T. National Center for Hyperbaric Medicine, Institute of Maritime and Tropical Medicine, Medical University of Gdansk, Powstania Styczniowego 9B, Gdynia 81-519, Poland.

Both the longest tissue half-time (T_{1/2max}) and the maximum allowable pressure gradient (ΔP) define the safe rate of decompression (DR) after saturation expositions. The mathematical relation between them ($DR = -k \times \Delta P$, where: $k = \ln(2)/(T_{1/2max})$) suggests that experimentally established decompression rate can be hypothetically described by the infinite number of T_{1/2max} and ΔP combinations. The observed number of decompression sickness after saturation decompressions forced to change those parameters subsequently and finally led to values far outside physiological range. Therefore the aim of this study was to compare values of the longest tissue half-time of nitrogen desaturation from diver's body published since 1908 in order to present the evolution of opinions concerning desaturation process. Non-physiological values of T_{1/2max} (from 75 to 1280 minutes) have been published during historical evolution of decompression tables and systems. The currently accepted values of T_{1/2max} (in the range of 320-480 minutes) for saturation and non-saturation air and nitrox divers and hypobaric decompressions, still need to be

precised. The discrepancy between T_{1/2max} values obtained using isobaric decompression method and decompressions after diving indicates different physiological phenomena during nitrogen elimination in both methods.
PMID: 14974784 [PubMed - indexed for MEDLINE]

10: Neth J Med. 2003 Nov;61(11):388-9; author reply 389.

Comment on: Neth J Med. 2003 Feb;61(2):50-3.

More on bleomycin and scuba diving. White RM.

Publication Types: Comment Letter

PMID: 14768724 [PubMed - indexed for MEDLINE]

11: Evolution Int J Org Evolution. 2003 Dec;57(12):2819-34.

Evolution of subterranean diving beetles (Coleoptera: Dytiscidae: Hydroporini, Bidessini) in the arid zone of Australia.

Leys R, Watts CH, Cooper SJ, Humphreys WF.

South Australian Museum, North Terrace, Adelaide, South Australia 5000, Australia.

leijs.remko@saugov.sa.gov.au

Calcrete aquifers in arid inland Australia have recently been found to contain the world's most diverse assemblage of subterranean diving beetles (Coleoptera: Dytiscidae). In this study we test whether the adaptive shift hypothesis (ASH) or the climatic relict hypothesis (CRH) is the most likely mode of evolution for the Australian subterranean diving beetles by using a phylogeny based on two sequenced fragments of mitochondrial genes (CO1 and 16S-tRNA-ND1) and linearized using a relaxed molecular clock method. Most individual calcrete aquifers contain an assemblage of diving beetle species of distantly related lineages and/or a single pair of sister species that significantly differ in size and morphology. Evolutionary transitions from surface to subterranean life took place in a relatively small time frame between nine and four million years ago. Most of the variation in divergence times of the sympatric sister species is explained by the variation in latitude of the localities, which correlates with

the onset of aridity from the north to the south and with an aridity maximum in the Early Pliocene (five mya). We conclude that individual calcrete aquifers were colonized by several distantly related diving beetle lineages. Several lines of evidence from molecular clock analyses support the CRH, indicating that all evolutionary transitions took place during the Late Miocene and Early Pliocene as a result of aridification.

PMID: 14761060 [PubMed - indexed for MEDLINE]

12: Undersea Hyperb Med. 2003 Winter;30(4):313-20.

Use of speech production repair strategies to improve diver communication.

Mendel LL, Walton JH, Hamill BW, Pelton JD.

School of Audiology and Speech-Language Pathology, The University of Memphis, Memphis, TN 38105, USA.

The purpose of this investigation was to determine if speech intelligibility improved when divers made specific modifications to their speaking patterns while in a hyperbaric helium-oxygen (heliox) environment. Divers were trained to produce a variety of sentences using speech with three types of alterations: (1) slowed rate, (2) increased loudness, and (3) a combination of slightly slowed rate, a minimal increase in loudness, increased pause time, and greater mouth opening (composite strategy). Both diver and non-diver listeners judged these sentences for intelligibility. In addition, acoustic analysis of the cues for the identification of voicing, place, and manner of articulation was conducted to determine if such cues might become more audible in the speech signal when repair strategies were used. Both perceptual and acoustic results showed the composite method to be the best for natural-sounding, intelligible speech. It had the effect of slowing rate and increasing loudness just enough to increase intelligibility without causing distortion. It was concluded that teaching divers to produce speech using this method would be a worthwhile investment for improving speech intelligibility.

PMID: 14756234 [PubMed - indexed for MEDLINE]

13: Undersea Hyperb Med. 2003 Winter;30(4):293-303.

Change in strategy of solving psychological tests: evidence of nitrogen narcosis in shallow air-diving.

Petri NM.

Department of Undersea and Hyperbaric Medicine, Naval Medical Institute, Split, Croatia.

The depths from 10 to 30 m are usually not considered narcotic in scuba air-diving, and evidence of psychomotor disturbances attributable to nitrogen narcosis at these depths is weak and contradictory. 15 experienced male divers were tested in a chamber at 1, 2, 3, and 4 bars over five consecutive days using a battery of computer generated psychological tests-Computerized Reactionmeter Drenovac (CRD-series). Total test solving time, minimal single task solving time, total "ballast" time, and total number of errors were recorded. Nitrogen narcosis effects were evident at all hyperbaric pressures with marked performance differences among subjects. MANOVA revealed significant effects of nitrogen partial pressure for groups of the same variables as follows: total test solving time ($p < 0.001$), total "ballast" time ($p < 0.001$), and total number of errors ($p = 0.038$), but not for minimal single task solving time. ANOVA showed significant effects of pressure only on tests of visual discrimination of signal location (total test solving time: $p = 0.012$, total "ballast" time: $p < 0.001$), simple convergent visual orientation (total test solving time: $p = 0.012$), and convergent thinking (total test solving time: $p = 0.002$, total number of errors: $p = 0.049$). The order of the pressure exposures had no influence on subject performance. Impaired psychomotor processing found during air exposures from 2 to 4 bars suggests that nitrogen narcosis at depths usually considered safe from its effects might be a problem in underwater operations that require accuracy, speed, limited time of performance, and complex psychomotor skills.

PMID: 14756232 [PubMed - indexed for MEDLINE]

14: Undersea Hyperb Med. 2003 Winter;30(4):285-91.

Measurement of fatigue following 18 msw dry chamber dives breathing air or enriched air nitrox.

Harris RJ, Doolette DJ, Wilkinson DC, Williams DJ.

Hyperbaric Medicine Unit, Royal Adelaide Hospital, Adelaide, South Australia 5000.

Many divers report less fatigue following diving breathing oxygen rich N₂-O₂ mixtures compared with breathing air. In this double blinded, randomized controlled study 11 divers breathed either air or Enriched Air Nitrox 36% (oxygen 36%, nitrogen 64%) during an 18 msw (281 kPa(a)) dry chamber dive for a bottom time of 40 minutes. Two periods of exercise were performed during the dive. Divers were assessed before and after each dive using the Multidimensional Fatigue Inventory-20, a visual analogue scale, Digit Span Tests, Stroop Tests, and Divers Health Survey (DHS). Diving to 18m produced no measurable difference in fatigue, attention levels, ability to concentrate or DHS scores, following dives using either breathing gas.

Publication Types: Clinical Trial
Randomized Controlled Trial

PMID: 14756231 [PubMed - indexed for MEDLINE]

15: Undersea Hyperb Med. 2003 Winter;30(4):277-84.

An outbreak of Methicillin-resistant Staphylococcus aureus cutaneous infection in a saturation diving facility.

Wang J, Barth S, Richardson M, Corson K, Mader J.

Division of Hyperbaric Medicine and Wound Care, Department of Orthopaedics and Rehabilitation, University of Texas Medical Branch, USA.

We present a molecular epidemiological investigation of an outbreak of cutaneous tissue infection, which involved six divers during a 45 day saturation exposure dive. The cutaneous infection manifested as boils, folliculitis and small abscesses involving different body sites, including nose, external

ear canal, necks, back, extremities, and buttocks. Staphylococcus aureus was consistently isolated from the skin lesions of affected divers. A study of the antibiogram revealed that all Staphylococcus aureus isolates were uniformly resistant to penicillin, oxacillin and erythromycin, but sensitive to clindamycin, tetracycline, trimethoprim-sulfamethoxazole, rifampin and vancomycin. Molecular typing by pulse field gel electrophoresis (PFGE) demonstrated that all the Methicillin-resistant Staphylococcus aureus (MRSA) isolates had an indistinguishable pulsed field gel electrophoresis pattern. The source of outbreak was identified as a colonized diver (diver D). Personal contact was most likely the mode of transmission among the six divers. Infection with MRSA should be suspected in outbreaks of boils that are not responding to standard antibiotic therapy among healthy divers and their close contacts. To our knowledge, this is the first report of Methicillin-resistant Staphylococcus aureus (MRSA) outbreak in a saturation diving facility.

PMID: 14756230 [PubMed - indexed for MEDLINE]

16: Sports Biomech. 2003 Jul;2(2):251-65.

Technique and timing in women's inward two and one half somersault tuck (405C) and the men's inward two and one half somersault pike (405B) 3 m springboard dives.

Sanders R, Burnett A.
University of Edinburgh, Edinburgh, UK.

The purpose of this study was to compare the inward two and one half somersault dive in a tuck position (405C) performed by females (n = 22) and the inward two and one half somersault dive in a pike position (405B) performed by males (n = 24) to determine changes required by females to successfully perform 405B. Key performance variables in inward dives were also compared to those of backward dives. Video data of the dives performed at the 1999 FINA World Diving Cup were captured and digitized to obtain times and postures of the divers at specific events including takeoff and entry.

Estimates of flight height and mass-normalised work done on the springboard were obtained from flight times. Some females worked the springboard strongly enough to generate sufficient height and rotation to perform 405B. Males performed 405B comfortably because they achieved better height and rotation than the females. A comparison of backward and inward dives revealed that divers are able to attain greater height in backward dives than inward dives.
PMID: 14737932 [PubMed - indexed for MEDLINE]

17: Kulak Burun Bogaz Ihtis Derg. 2003 Sep;11(3):93-5.
[Current issues on sport SCUBA diving following otosclerosis surgery]
[Article in Turkish]
Uzun C.
Publication Types: Letter
PMID: 14699251 [PubMed - indexed for MEDLINE]

18: Lancet. 2003 Dec;362 Suppl:s10-1.
Human reactions to deep-water conditions.
Vaernes RJ, Sandal G.
Nutec Crisis Management, Norway.
rjv@nutec.no
PMID: 14698110 [PubMed - indexed for MEDLINE]

19: Aviat Space Environ Med. 2003 Dec;74(12):1275-6.
Comment on: Aviat Space Environ Med. 2003 Dec;74(12):1271-4.
Should divers smoke and vice versa?
Dillard TA, Ewald FW Jr.
Pulmonary Critical Care Section, Department of Medicine, Medical College of Georgia, Augusta, GA 30912, USA. tdillard@mail.mcg.edu
Publication Types: Comment
PMID: 14692471 [PubMed - indexed for MEDLINE]

20: Aviat Space Environ Med. 2003 Dec;74(12):1271-4.
Comment in: Aviat Space Environ Med. 2003 Dec;74(12):1275-6.
Cigarette smoking and decompression illness severity: a retrospective study in recreational divers.
Buch DA, El Moalem H, Dovenbarger JA, Uguccioni DM, Moon RE.
Department of Anesthesiology, Center for Hyperbaric Medicine and

Environmental Physiology, Duke University Medical Center, Durham, NC 27710, USA.

BACKGROUND: Severe decompression illness (DCI) could be more likely in cigarette smokers because of airway obstruction or vascular disease. The present study evaluated the severity of DCI as a function of cigarette smoking in recreational divers. METHODS: We examined all DCI reports recorded in the Divers Alert Network (DAN) database from 1989 through 1997. Smoking history was quantified as heavy (>15 pack-years), light (0 to 15 pack-years), and never smoked. DCI symptoms were classified as severe (alteration in consciousness, balance or bladder/bowel control, motor weakness, visual symptoms, convulsions), moderate (other neurological symptoms), or mild (pain, skin, or nonspecific symptoms). The proportional odds model and generalized logits were used for the adjusted analysis when accounting for other covariates. RESULTS: There were 4,350 patients included in the analysis. After adjustment for confounding variables, heavy smokers were more likely to have severe vs. mild symptoms than nonsmokers (OR = 1.88) (95% CI 1.36, 2.60) or light smokers (OR = 1.56) (95% CI 1.09, 2.23). Heavy smokers and light smokers were more likely to have severe vs. moderate symptoms than nonsmokers (OR = 1.36) (95% CI 1.06, 1.74) and (1.22) (1.02, 1.46), respectively. Although these data do not reveal whether smoking predisposes to DCI, the results are consistent with a tendency, when DCI occurs, for cigarette smoking to trigger more severe symptoms. CONCLUSIONS: The data suggest that when DCI occurs in recreational divers, smoking is a risk factor for increased severity of symptoms.
PMID: 14692470 [PubMed - indexed for MEDLINE]

21: J Laryngol Otol. 2003 Nov;117(11):854-60.
Alternobaric vertigo in sport SCUBA divers and the risk factors.
Uzun C, Yagiz R, Tas A, Adali MK, Inan N, Koten M, Karasalihoglu AR.
Department of Oto-Rhino-Laryngology, Head and Neck Surgery, Trakya

University, Faculty of Medicine, Edirne, Turkey. cemuzun@yahoo.com

We investigated the eustachian tube function and the incidence of alternobaric vertigo (AV) in 29 sport self-contained underwater breathing apparatus (SCUBA) divers with, or without, some possible risk factors for AV. The divers had normal audiological and otoscopic findings at the pre-dive examination. We used the nine-step inflation/deflation tympanometric test and Toynbee test for evaluation of eustachian tube function, and the Valsalva manoeuvre for patency. Information on divers, their history, and their otolaryngologic examination were obtained in the pre-dive examination. Divers performed 1086 dives (mean 37, range: 3-100) during the observation period. Four divers (14 per cent) experienced AV during five dives (0.46 per cent), (one diver experienced AV two times). It was found that having an otitis media history or eustachian tube dysfunction determined with the nine-step inflation/deflation tympanometric test before diving, or difficulty in clearing ears during diving could be important risk factors for AV in sport SCUBA divers ($p < .05$). Divers with such findings seem to be more prone to AV and should pay rigorous attention to the precautions for prevention of AV.

PMID: 14670144 [PubMed - indexed for MEDLINE]

22: *Comp Biochem Physiol A Mol Integr Physiol.* 2003 Dec;136(4):799-809.

Diving behaviour, dive cycles and aerobic dive limit in the platypus *Ornithorhynchus anatinus*.

Bethge P, Munks S, Otley H, Nicol S. *Anatomy and Physiology, University of Tasmania, Private Bag 24, Hobart, Tasmania 7001, Australia.* philip@bethge.org

We investigated the diving behaviour, the time allocation of the dive cycle and the behavioural aerobic dive limit (ADL) of platypuses (*Ornithorhynchus anatinus*) living at a sub-alpine Tasmanian lake. Individual platypuses were equipped with combined data logger-transmitter packages measuring dive depth. Mean dive duration was 31.3 s with 72% of

all dives lasting between 18 and 40 s. Mean surface duration was 10.1 s. Mean dive depth was 1.28 m with a maximum of 8.77 m. Platypuses performed up to 1600 dives per foraging trip with a mean of 75 dives per hour. ADL was estimated by consideration of post-dive surface intervals vs. dive durations. Only 15% of all dives were found to exceed the estimated ADL of 40 s, indicating mainly aerobic diving in the species. Foraging platypuses followed a model of optimised recovery time, the optimal breathing theory. Total bottom duration or total foraging duration per day is proposed as a useful indicator of foraging efficiency and hence habitat quality in the species.

PMID: 14667845 [PubMed - indexed for MEDLINE]

23: *Proc R Soc Lond B Biol Sci.* 2003 Dec 7;270(1532):2451-5.

The effect of foraging parameters on the probability that a dive is successful.

Houston AI, McNamara JM, Heron JE, Barta Z. *Centre for Behavioural Biology, School of Biological Sciences, University of Bristol, Bristol BS8 1UG, UK.*

In this paper, we investigate the foraging decisions of an animal that dives to obtain its food. It might seem reasonable to use the probability that the diver is successful in any dive as an indicator of habitat quality. We use a dynamic model of optimal prey choice to show that this interpretation of diving success is not generally valid. In particular, we show that diving success is not directly proportional to the overall rate of gain that can be achieved in an environment. Furthermore, some environmental factors can have a non-monotonic effect on the probability of success. For example, as the travel time to the foraging area increases, the probability of success may first increase and then decrease. We point out that the same conclusions are likely to apply in the context of mate choice, i.e. the probability of getting a mate may not be an indicator of the quality of the environment in terms of reproductive success.

PMID: 14667334 [PubMed - indexed for MEDLINE]

24: Mayo Clin Proc. 2003 Dec;78(12):1557-60.

Acute myocardial infarction in a professional diver after jellyfish sting.

Salam AM, Albinali HA, Gehani AA, Al Suwaidi J.

Department of Cardiology and Cardiovascular Surgery, Hamad Medical Corporation, Doha, State of Qatar.

To our knowledge, acute myocardial infarction after jellyfish envenomation has not been reported previously. We describe a previously healthy 45-year-old male diver who had an acute inferior myocardial infarction with right ventricular involvement after a jellyfish sting on his left forearm while diving in the Gulf Sea. The patient had a normal controlled ascent after the incident. He had no risk factors for coronary artery disease, and cardiac catheterization revealed normal coronary arteries. Acute myocardial infarction should be considered in patients who experience chest pain or have hemodynamic compromise after jellyfish envenomation.

Publication Types: Case Reports
PMID: 14661686 [PubMed - indexed for MEDLINE]

25: Laryngoscope. 2003 Dec;113(12):2141-7.

Inner ear decompression sickness and inner ear barotrauma in recreational divers: a long-term follow-up.

Shupak A, Gil A, Nachum Z, Miller S, Gordon CR, Tal D.

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OBJECTIVES/HYPOTHESIS: The objectives were to report the authors' experience with the long-term follow-up of patients with diving-related inner ear decompression sickness and inner ear barotrauma and to discuss residual cochlear and vestibular damage in relation to the question of fitness to dive. STUDY DESIGN: Retrospective consecutive case series. METHODS: Eleven recreational divers with inner ear decompression sickness and nine with inner ear barotrauma (IEB) were followed. A complete

otoneurological physical examination and laboratory evaluation were carried out. The latter included audiometry, electronystagmography, a rotatory chair test using the sinusoidal harmonic acceleration protocol, and computerized dynamic posturography. RESULTS: Residual cochleovestibular deficits were found in 10 (91%) of the patients with inner ear decompression sickness and 3 (33%) of those with IEB (P <.02, Fisher's Exact test; odds ratio, 20). A significantly shorter follow-up period was required for the inner ear barotrauma group (P <.05, simple t test) because three patients (33%) recovered completely within 1 month of the diving accident. Eight patients had residual vestibular deficits on follow-up, but only one (12.5%) was symptomatic. However, five (56%) of the nine patients who had a cochlear insult, as documented by follow-up audiometry, complained of significant hearing loss and tinnitus. CONCLUSION: Inner ear decompression sickness carries a high risk for residual inner ear damage despite hyperbaric oxygen recompression therapy. A favorable prognosis might be anticipated for inner ear barotrauma. The finding that most patients with residual vestibular deficits were asymptomatic at the time of follow-up emphasizes the need for a complete vestibular evaluation, including specific bedside testing and laboratory examinations, before a return to diving activity may be considered.

PMID: 14660917 [PubMed - indexed for MEDLINE]

26: Sports Biomech. 2003 Jan;2(1):73-84.

Technique and timing in women's backward two and one half somersault tuck (205C) and the men's backward two and one half somersault pike (205B) 3m springboard dives.

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The purpose of this study was to compare the backward two and one half somersault dive in a tuck position (205C) performed by females (n = 22) and the backward two and one half somersault dive in a pike position (205B) performed by males

(n = 27) and by females (n = 6) to determine changes required by females to successfully perform 205B. Video data of the dives performed at the 1999 FINA World Diving Cup were captured and digitised to obtain times and postures of the divers at specific events including maximum depression, takeoff, and entry. Estimates of mass-normalised work done on the springboard were obtained from flight times. Males performed 31% more mass-normalised work on the springboard to gain height than females. Based on the dive scores and the short time to extend and prepare for entry it was concluded that females are not yet able to perform 205B with the same quality as they perform 205C. Females performing backward dives need to adjust their techniques to allow increased work on the springboard to generate height and rotation. Also, faster contraction of the hip flexors may allow them to achieve the tightest position more quickly to complete rotations with more time to prepare for entry.

PMID: 14658247 [PubMed - indexed for MEDLINE]

27: J Laryngol Otol. 2003 Oct;117(10):756-62.

Shrapnell's membrane in a mammal exposed to extreme pressure variations: morphological and radiological observations in the hooded seal.

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The function of Shrapnell's membrane (pars flaccida; PF) in middle-ear mechanics is still an enigma, though numerous proposals have been put forward, e.g. protection of pars tensa, equalizing of middle-ear pressure, sound transmission, and the site of origin of otitis media. In this study the PF was studied in a mammal (the hooded seal) which exposes itself to extreme pressure differences (from 1 to 100 atmospheres) when diving. Formaldehyde-fixed temporal bones obtained from newborn, one-year-old, and adult seals (three of each) were cleansed and decalcified in 10 per cent EDTA. The lateral wall of the

middle-ear cavity, including the whole tympanic membrane with its bony surroundings, was then excised and photodocumented. Thin sections were cut parallel with, and perpendicular to, the handle of the malleus, stained with haematoxylin-eosin, toluidine blue or Giemsa stain and examined under a light microscope. One seal head was subjected to high resolution computerized tomography (HRCT) before sectioning. The PF was observed to be a narrow fissure measuring a maximum of 0.8 mm between processus brevis of the malleus and the notch of Rivinus in pars squamosa (pars tensa diameter 10-12 mm). It seems unlikely that the PF of the hooded seal participates in pressure equalization in the middle ear. The main function of the lateral wall of the attic, including the minimal PF, appears to be to protect the middle-ear ossicles and allow movement of the malleus.

PMID: 14653915 [PubMed - indexed for MEDLINE]

28: Vet Hum Toxicol. 2003 Dec;45(6):307-9.

Sea-urchin envenomation.

Wu ML, Chou SL, Huang TY, Deng JF.

Division of Clinical Toxicology, Department of Medicine, Taipei Veterans General Hospital, Taiwan.

Sea-urchin stings may produce injurious and venomous wounds. Although numerous writers refer to the danger of pedicellariar stings, there is little worth-while clinical data. We report a case of sea-urchin injury with severe local reaction and acute hepatitis. A 47-y-o Taiwanese woman accidentally stepped on a sea urchin while scuba diving on a beach in Palau Islands. The puncture wounds were numerous and she felt faintness, and immediate and intense pain. Initial management included partial spine removal, betadine immersion, intravenous fluid and analgesics. She developed fever, chills, nausea, and persistent serous discharge and tenderness from the sites of stings in the following days. She was admitted due to right foot cellulitis, sea-urchin injuries of both soles and suspected toxic hepatitis on the 7th day after envenomation. Serum alanine

transaminase was 810 U/L and aspartate transaminase 320 U/L; she received i.v. antibiotics and wound debridement for removal of residual stings. She recovered gradually and was discharged 2 w later. Travel related marine animal injury has an increasing tendency throughout the world. This case had the unusual presentation of severe local reaction and hepatitis; immediate and more aggressive spine removal might have lessened the degree of injury.

PMID: 14640480 [PubMed - indexed for MEDLINE]

29: J Forensic Sci. 2003 Nov;48(6):1347-55.

Virtopsy-postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI) in a fatal scuba diving incident.

Plattner T, Thali MJ, Yen K, Sonnenschein M, Stoupis C, Vock P, Zwygart-Brugger K, Kilchor T, Dirnhofer R.

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The body of a 44-year-old scuba diver was examined using postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI), and findings were verified by subsequent autopsy. The goal was to find out whether the important pathomorphological findings for the reconstruction of events and the identification of cause and manner of death could be identified using modern digital cross-sectioning techniques. The findings of a massive vital decompression with pulmonary barotrauma and lethal gas embolism were identified in the radiological images. MSCT and MRI were superior to autopsy in the demonstration of the extent and distribution of gas accumulation in intraparenchymal blood vessels of internal organs as well as in areas of the body inaccessible by standard autopsy.

Publication Types: Case Reports
PMID: 14640284 [PubMed - indexed for MEDLINE]

30: Ann Emerg Med. 2003 Dec;42(6):763-6.

Irukandji-like syndrome in South Florida divers.

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Irukandji syndrome is a constellation of delayed severe local and systemic symptoms occurring after a *Carukia barnesi* box jellyfish sting involving any exposed skin. These cases are limited to Australia, the habitat of that animal. Numerous other cases of an Irukandji-like syndrome after other small Carybdeid genus envenomations have been reported elsewhere in the world. There have yet been no reports of Irukandji-like syndrome occurring in continental US coastal waters. We describe 3 cases of marine envenomation causing such a symptom complex in US military combat divers off Key West, FL. It is unclear what species caused the injuries, but a member of the Carybdeid genus seems most likely.

Publication Types: Case Reports
PMID: 14634600 [PubMed - indexed for MEDLINE]

31: Resuscitation. 2003 Nov;59(2):171-80.

Comment in: Resuscitation. 2004 May;61(2):237-8; author reply 239. Resuscitation. 2004 May;61(2):239-40; discussion 240; author reply 240.

Diving emergencies.

DeGorordo A, Vallejo-Manzur F, Chanin K, Varon J.

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Self-Contained Underwater Breathing Apparatus (SCUBA) diving popularity is increasing tremendously, reaching a total of 9 million people in the US during 2001, and 50,000 in the UK in 1985. Over the past 10 years, new advances, equipment improvements, and improved diver education have made SCUBA diving safer and more enjoyable. Most diving injuries are related to the behaviour of the gases and pressure changes during descent and ascent. The four main pathologies in diving medicine include: barotrauma (sinus, otic, and pulmonary); decompression illness (DCI); pulmonary edema and pharmacological; and toxic effects of increased partial pressures of gases. The clinical manifestations

of a diving injury may be seen during a dive or up to 24 h after it. Physicians living far away from diving places are not excluded from the possibility of encountering diver-injured patients and therefore need to be aware of these injuries. This article reviews some of the principles of diving and pathophysiology of diving injuries as well as the acute treatment, and further management of these patients.

Publication Types: Review
Review, Tutorial
PMID: 14625107 [PubMed - indexed for MEDLINE]

32: Aviat Space Environ Med. 2003 Nov;74(11):1201-4.

Pulmonary edema following closed-circuit oxygen diving and strenuous swimming.

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Acute pulmonary edema may be induced by diving and strenuous swimming. We report the case of a diver using closed-circuit, scuba equipment who developed acute dyspnea, hemoptysis, and hypoxemia following a dive in 18 degreesC (64.4 degrees F) water and physical exertion during the swim back to shore. With the growing popularity of recreational scuba diving, emergency physicians are liable to be faced with increasing numbers of diving-related medical problems. Diving-induced pulmonary edema should be included in the differential diagnosis of acute hypoxemia, sometimes accompanied by acid-base abnormalities, when this is seen in a diver.

Publication Types: Case Reports
PMID: 14620479 [PubMed - indexed for MEDLINE]

33: Aviat Space Environ Med. 2003 Nov;74(11):1177-82.

Decompression sickness in women: a possible relationship with the menstrual cycle.

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BACKGROUND: Women are increasingly participating in recreational scuba

diving and the professional roles of women are expanding in the fields of aviation, space, and diving. Evidence exists that there may be a relationship between altitude decompression sickness (DCS) and the menstrual cycle, although diving studies to support such findings are limited. The aim of the present study was to investigate the presence of any relationship between the development of DCS in female sports divers, the phase of the menstrual cycle, and the use of the oral contraceptive pill (OCP). METHOD: Personal, dive, symptom, and menstrual history details were collected by questionnaire from women treated with hyperbaric therapy for DCS in 23 treatment centers worldwide. RESULTS: There were 150 records suitable for analysis. The phase in the menstrual cycle of the DCS incident was estimated. The DCS incidents were unevenly distributed throughout the cycle ($p = 0.001$) with the greatest percentage of incidents occurring in the first week of the menstrual cycle. The variation in incidence across the cycle appeared to be greatest for the non-OCP users ($p = 0.01$), and when age was taken into account there was a significant difference between the OCP and non-OCP users with respect to risk of DCS across the menstrual cycle ($p = 0.03$). CONCLUSION: These data suggest that the risk of DCS may be dependent on the phase of the menstrual cycle and that the distribution of risk differs between OCP and non-OCP users.

PMID: 14620475 [PubMed - indexed for MEDLINE]

34: Aviat Space Environ Med. 2003 Nov;74(11):1163-8.

Risk of decompression sickness during exposure to high cabin altitude after diving.

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BACKGROUND: Postdive altitude exposure increases the risk of decompression sickness (DCS). Certain training and operational situations may require U.S. Special

Operations Forces (SOF) personnel to conduct high altitude parachute operations after diving. Problematically, the minimum safe preflight surface intervals (PFSI) between diving and high altitude flying are not known. METHODS: There were 102 healthy, male volunteers (34 +/- 10 [mean +/- SD] yr of age, 84.5 +/- 13.8 kg weight, 26.2 +/- 4.2 kg x m(-2) BMI) who completed simulated 60 fsw (feet of seawater)/60 min air dives preceding simulated 3-h flights at 25,000 ft to study DCS risk as a function of PFSI. Subjects were dry and at rest throughout. Oxygen was breathed for 30 min before and during flight in accordance with SOF protocols. Subjects were monitored for clinical signs of DCS and for venous gas emboli (VGE) using precordial Doppler ultrasound. DCS incidence was compared with Chi-squared; VGE onset time and time to maximum grade with one-way ANOVA (significance at $p < 0.05$). RESULTS: Three cases of DCS occurred in 155 subject-exposures: 1/35 and 0/24 in 2 and 3 h flight-only controls, respectively; 0/23, 1/37, and 1/36 for 24, 18, and 12 h dive-PFSI-flight profiles, respectively. DCS risk did not differ between profiles ($\chi^2 [4] = 1.33$; crit = 9.49). VGE were observed in 19% of flights. Neither VGE onset time nor time to max grade differed between profiles (82 +/- 38 min [$p = 0.88$] and 100 +/- 40 min [$p = 0.68$], respectively). CONCLUSION: Increased DCS risk was not detected as a result of dry, resting 60 fsw/60 min air dives conducted 24-12 h before a resting, 3-h oxygen-breathing 25,000 ft flight (following 30 min oxygen prebreathe). The current SOF-prescribed minimum PFSI of 24 h may be unnecessarily conservative.

Publication Types: Case Reports
Clinical Trial Controlled
Clinical Trial
PMID: 14620473 [PubMed - indexed for MEDLINE]

35: Undersea Hyperb Med. 2003 Fall;30(3):181-93.
Decompression profile and bubble formation after dives with surface decompression: experimental support for a dual phase model of decompression.

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The present study was initiated in order to determine the effect of decompression profiles on bubble formation following surface decompression using oxygen. Following an air dive to 496 kPa (130 fsw) for 90 minutes, three different profiles were tested in the pig; a USN staged decompression profile, a profile using linear continuous decompression with the same total decompression time as the USN profile (ABI) and a linear profile with half the total decompression time compared to the first two (ABII). The subsequent surface decompression at 220 kPa lasted 68 minutes for all three schedules. The study demonstrated that, following final decompression, the two linear profiles produced the lowest amount of vascular gas, with the fastest profile producing significantly less bubbles in the Pulmonary artery than the other two. Similar results were obtained in the jugular vein. The results are in qualitative agreement with model simulation using the Reduced Gradient Bubble Model (RGBM), demonstrating that the controlling tissues are reduced from those with a half time of 40 minutes using the USN procedure to 5 minutes using the fastest linear profile.

PMID: 14620098 [PubMed - indexed for MEDLINE]

36: J Sci Med Sport. 2003 Sep;6(3):348-54.

Long term retention of safe diving skills.

Blitvich JD, McElroy GK, Blanksby BA, Parker HE.

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This short report describes a 20-month follow-up of safe diving skills, extending the 8-month retention period previously published in this journal. Thirty-four recreational swimmers with poor diving skills were evaluated before and immediately after a diving skills intervention program. Twenty-two returned for the eight-month follow-up evaluation and 16 returned 20 months post. As with the earlier

study, Treadwater, Deck, Block and Running dives were video-recorded, and maximum depth, distance, velocity, entry angle and flight distance were compared. Underwater hand and arm positions were examined. Pre-intervention, a breaststroke arm action before maximum depth occurred in 18% of all dives and 38% of Treadwater dives. This was eliminated post-intervention, improving head protection. The Treadwater dive elicited the greatest mean maximum depth, and ANOVA showed depth for this entry decreased (improved) following intervention and remained shallower at the eight-month and 20-month post follow-ups. The Block dive also became shallower following intervention while the Deck dive remained unchanged. As seven 10-minute skills sessions resulted in shallower dives with safer hand and arm positions, and these skills were retained over a 600 day non-practice period, it is reliable to consider that the inclusion of safe diving skills in learn-to-swim programs can provide a diving spinal cord injury prevention strategy.

PMID: 14609152 [PubMed - indexed for MEDLINE]

37: Ned Tijdschr Tandheelkd. 2003 Oct;110(10):403-5.

[Gingiva damaged by ill-fitting scuba-diving mouthpiece]
[Article in Dutch]

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A 46-year old man presented a hyperlasia of the marginal gingiva of a mandibular molar. The reason of the hyperlasia could be found after further anamnestic questions: irritation by pressure of an ill-fitting scuba-diving mouthpiece. The patient was sports-diver and instructor. After instructions to the patient and an expectative approach, the hyperplasia disappeared spontaneously within a few months, without any kind of therapy.

Publication Types: Case Reports
PMID: 14606248 [PubMed - indexed for MEDLINE]

38: Biometrics. 2003 Sep;59(3):512-20.

Abundance estimation of diving animals by the double-platform line transect method.

Okamura H, Kitakado T, Hiramatsu K, Mori M.

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In conventional line transect theory, it is assumed that all animals on the line are detected. This article introduces an extended and generalized hazard probability model without the need for such an assumption. The proposed method needs a survey design with independent observers having the same visual region and assumes an explicit distinction of simultaneous and delayed duplicates. It can take account of random heterogeneity caused by surfacing behavior as well as systematic heterogeneity by covariate effects. Furthermore, it can be easily extended to cases in which data from incompletely independent observers are available. The abundance estimate is based on the Horvitz-Thompson estimator in unequal detectability sampling scheme. Simulation studies suggest that the proposed method has good performance. The method is applied to a real data set on Antarctic minke whales in the illustration.

PMID: 14601752 [PubMed - indexed for MEDLINE]

39: Space Med Med Eng (Beijing). 2003 Aug;16(4):307-8.

[Changes of serum IL-1, IL-2R and TNF-alpha levels in divers after 150 m Heliox saturation -182 m excursion in the open sea diving]

[Article in Chinese]

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Objective: To observe the change of the serum IL-1, IL-2R and TNF-alpha levels in divers after deep saturation in the open sea diving. Method: Eight divers experienced 150 in Heliox saturation -182 in excursion diving. Serum levels of IL-1, IL-2R and TNF-alpha level before and after diving were measured by ELISA. Results: There was no significant change of serum TNF-alpha level after saturation

diving, but serum levels of IL-1, IL-2R increased significantly after saturation diving. Conclusion: Deep open sea saturation diving had significant effects on serum IL-6, IL-2R levels of the divers.
PMID: 14594044 [PubMed - indexed for MEDLINE]

40: Wilderness Environ Med. 2003 Fall;14(3):193.
Comment in: Wilderness Environ Med. 2003 Fall;14(3):191-2.
Changes in body temperature and basal metabolic rate of the Ama. 1963.
Kang BS, Song SH, Suh CS, Hong SK.
Publication Types: Biography
Classical Article Historical Article
Personal Name as Subject: Kang BS Song SH Suh CS Hong SK
PMID: 14582502 [PubMed - indexed for MEDLINE]

41: Aviat Space Environ Med. 2003 Oct;74(10):1101-4.
Hand discomfort following heliox chamber dives.
Benton PJ, Anthony G.
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During a series of dry chamber dives using compressed heliox, five attendants and one wet diver experienced eight episodes of hand discomfort, the character of which was atypical of limb pain during decompression sickness. Although immersed for most of the dive, during the compression and decompression phases, the wet diver's hands were out of the water and hence exposed to the helium-containing chamber atmosphere. In all cases, symptoms resolved within a maximum of 48 h. There was no response to hyperbaric oxygen therapy in the three cases that presented before spontaneous resolution. While the attendants wore dry suits to minimize skin absorption of helium, their hands, were exposed to the heliox atmosphere. After the first six cases of hand symptoms, a dry glove assembly was added to prevent helium absorption through the exposed hand. Two cases of hand discomfort occurred following the addition of the dry glove assembly to the dry suit. In both cases, the symptoms

were less severe and resolved over a significantly shorter time period. Adoption of the dry gloves resulted in the incidence of hand discomfort among attendants falling from 25% (5/20) to 2.4% (2/84) ($p = 0.005$). Possible mechanisms of causation of this hand discomfort, thought to be the result of local tissue absorption of helium, are discussed.
Publication Types: Case Reports
PMID: 14556574 [PubMed - indexed for MEDLINE]

42: Aviat Space Environ Med. 2003 Oct;74(10):1058-60.
Association between right-to-left shunts and brain lesions in sport divers.
Gerriets T, Tetzlaff K, Hutzelmann A, Liceni T, Kopsike G, Struck N, Reuter M, Kaps M.
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BACKGROUND: Recent studies suggest that healthy sport divers may develop clinically silent brain damage, based on the association between a finding of multiple brain lesions on MRI and the presence of right-to-left shunt, a pathway for venous gas bubbles to enter the arterial system. METHODS: We performed echocontrast transcranial Doppler sonography in 42 sport divers to determine the presence of a right-to-left shunt. Cranial MRI was carried out using a 1.5 T magnet. A lesion was counted if it was hyperintense on both T2-weighted and T2-weighted fluid attenuated inversion recovery sequences. To test the hypothesis that the occurrence of postdive arterial gas emboli is related to brain lesions on MRI, we measured postdive intravascular bubbles in a subset of 15 divers 30 min after open water scuba dives. RESULTS: Echocontrast transcranial Doppler sonography revealed a right-to-left shunt in 16 of the divers (38%). Only one hyperintensive lesion of the central white matter was found and that was in a diver with no evidence of a right-to-left shunt. Postdive arterial gas emboli were detected in 3 out of 15 divers; they had a right-to-left shunt, but no pathologic findings on cranial

magnetic resonance imaging.
CONCLUSIONS: Our data support the theory that right-to-left shunts can serve as a pathway for venous gas bubbles into the arterial circulation. However, we could not confirm an association between brain lesions and the presence of a right-to-left shunt in sport divers.
PMID: 14556567 [PubMed - indexed for MEDLINE]

43: J Exp Biol. 2003 Nov;206(Pt 22):4139-54.

Adaptations to diving hypoxia in the heart, kidneys and splanchnic organs of harbor seals (*Phoca vitulina*).
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Pinnipeds (seals and sea lions) have an elevated mitochondrial volume density [V_V(mt)] and elevated citrate synthase (CS) and beta-hydroxyacyl-CoA dehydrogenase (HOAD) activities in their swimming muscles to maintain an aerobic, fat-based metabolism during diving. The goal of this study was to determine whether the heart, kidneys and splanchnic organs have an elevated V_V(mt) and CS and HOAD activities as parallel adaptations for sustaining aerobic metabolism and normal function during hypoxia in harbor seals (*Phoca vitulina*). Samples of heart, liver, kidney, stomach and small intestine were taken from 10 freshly killed harbor seals and fixed in glutaraldehyde for transmission electron microscopy or frozen in liquid nitrogen for enzymatic analysis. Samples from dogs and rats were used for comparison. Within the harbor seal, the liver and stomach had the highest V_V(mt). The liver also had the highest CS activity. The kidneys and heart had the highest HOAD activities, and the liver and heart had the highest lactate dehydrogenase (LDH) activities. Mitochondrial volume densities scaled to tissue-specific resting metabolic rate [V_V(mt)/RMR] in the heart, liver, kidneys, stomach and small intestine of harbor seals were elevated (range 1.2-6.6x) when compared with those in the dog and/or rat. In addition, HOAD

activity scaled to tissue-specific RMR in the heart and liver of harbor seals was elevated compared with that in the dog and rat (3.2x and 6.2x in the heart and 8.5x and 5.5x in the liver, respectively). These data suggest that organs such as the liver, kidneys and stomach possess a heightened ability for aerobic, fat-based metabolism during hypoxia associated with routine diving. However, a heightened LDH activity in the heart and liver indicates an adaptation for the anaerobic production of ATP on dives that exceed the animal's aerobic dive limit. Hence, the heart, liver, kidneys and gastrointestinal organs of harbor seals exhibit adaptations that promote an aerobic, fat-based metabolism under hypoxic conditions but can provide ATP anaerobically if required.

PMID: 14555753 [PubMed - indexed for MEDLINE]

44: J Exp Biol. 2003 Nov;206(Pt 22):4105-11.

Immunohistochemical fiber typing of harbor seal skeletal muscle.

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There is strong evidence that pinnipeds maintain a lipid-based, aerobic metabolism during diving. However, the few fiber-typing studies performed on pinniped skeletal muscles are not consistent with an aerobic physiological profile. The objective of this study was to reexamine the fiber type distribution throughout the primary locomotory muscles of the harbor seal *Phoca vitulina*. Results from immunohistochemical (IHC) fiber typing indicated that harbor seal swimming muscles (the epaxial muscles) are composed of 47.4% type I (slow twitch, oxidative) fibers and 52.8% IIA (fast twitch, oxidative) fibers, which are homogeneously distributed throughout the muscle. Harbor seal pectoralis, a secondary swimming muscle, was composed of 16.2% type I and 84.3% type IIA fibers. No fast twitch, glycolytic (type IIB) fibers were detected in either muscle, in contrast to published data on fiber typing of harbor seal epaxial muscles using traditional histochemical techniques. The

extreme specificity inherent in the IHC fiber typing procedure leads us to conclude that harbor seal swimming muscle is entirely composed of oxidative fibers. Our results are consistent with the enzymatic analyses of pinniped skeletal muscle that support the use of lipid-derived aerobic catabolism to fuel working muscle during diving in these marine mammals.
PMID: 14555750 [PubMed - indexed for MEDLINE]

45: Hawaii Med J. 2003 Aug;62(8):165-70.
Descriptive epidemiological analysis of diving accidents in Hawaii from 1983 to 2001.
Nakayama H, Smerz RW.
UH, Dept. of Physiology, 1960 East-West Rd., Honolulu, HI 96822, USA. oceanhami@hotmail.com
The Hyperbaric Treatment Center (HTC) at the University of Hawaii, has evaluated and treated over 1100 divers for dysbaric disease from 1983 to 2001. We describe some epidemiological parameters and compare trends between local residents and tourist divers in this article. Data obtained from this review were analyzed for age, gender, type of injury and resident status. While trends in Hawaii have mirrored national figures, we did determine that there were some significant differences between resident and tourist divers' patterns of injury over this period of time.
Publication Types: Review
Review, Tutorial
PMID: 14533348 [PubMed - indexed for MEDLINE]

46: Rev Neurol. 2003 Sep 16-30;37(6):600; author reply 600.
Comment on: Rev Neurol. 2003 Jun 1-15;36(11):1040-4.
[Somatosensory evoked potentials in decompression sickness]
[Article in Spanish]
Ortega-Albas JJ, Salvador-Marin M.
Publication Types: Comment
Letter
PMID: 14533084 [PubMed - indexed for MEDLINE]

47: Comp Biochem Physiol A Mol Integr Physiol. 2003 Sep;136(1):205-13.

Diversity in and adaptation to breath-hold diving in humans.
Ferretti G, Costa M.
Department of Physiology, University Medical Centre, 1 rue Michel Servet, CH-1211 4, Geneva, Switzerland. guido.ferretti@medecine.unige.ch
Several features of potential adaptation to breath-hold diving in diving populations and extreme divers are reviewed. Thermal adaptation consists of an improvement in cold tolerance, as witnessed by a decrease in critical water temperature, and implies an elevation of the shivering threshold associated with a greater body insulation. This is indicative of either a strong peripheral vasoconstriction or a more effective countercurrent heat exchange. Respiratory adaptation consists of a blunted ventilatory response to carbon dioxide and an enlargement of lung volumes. Finally, the occurrence of a diving response has been demonstrated. An extreme peripheral vasoconstriction is associated with a dramatic increase in arterial blood pressure. The consequent stimulation of arterial baroreceptors causes an extreme drop of heart rate. Bradycardia is not compensated by a higher stroke volume, with consequent decrease in cardiac output. This decrease, however, is not such as to undermine perfusion to vital organs. Redistribution of blood flow occurs, and some organs such as skeletal muscle may become unperfused, as indicated by the high blood lactate concentrations at low metabolic rate. It is not possible to state, however, whether these changes reflect genetic adaptations or an adaptive response to a prolonged environmental stress.
Publication Types: Review
PMID: 14527641 [PubMed - indexed for MEDLINE]

48: J Physiol Anthropol Appl Human Sci. 2003 Sep;22(5):227-31.
Simulated high altitude diving experiment for the underwater construction operation.
Zhong-Yuan S, Xi-Wei T, Yan-Meng Z.
Chinese Underwater Technology Institute, China. haikeyuan@263.net
The simulated dive experiments were conducted at the high altitude of 4500 meters and 5000 meters, for the

requirement of diving operation in the lakes at the altitude of 4442 meters for the construction of large-scale hydroelectric power station. The high & low pressure chamber-complex was used, and 15 professional divers participated in the experiment. The divers were stayed at the altitude of 4500 and 5000 meters for 7-9 days. Totally 85 persons-times of dives to the depths of 30-50 meters were operated; they stayed under the water for 30-90 minutes while processing physical activities. During the experiment, we studied the pressurization procedure, decompression table, and physiological functions of the divers. The results indicate that, although the relative pressure differences between the surface and underwater was larger at high altitude than at sea level, the appropriate prolongation of the compression time was able to prevent the difficulty in pressure regulation for the divers to avoid the injury of middle ear. Four tables of the decompression A, B, C and D was calculated with Haldane's theory, and the speed of decompression increased in the order from A to D. The safest procedure was C, and there was no decompression sickness and bubbles in body of the divers. The methods of decompression included underwater stage decompression, surface decompression, oxygen-breathing decompression, and repetitive diving decompression. The surface decompression was the most suitable method for the high altitude, as it could greatly decrease the time in the cold water for the divers. The power spectrum analysis of EEG (electroencephalogram) indicated that, when the divers were exposed to the altitude of 5000 meters, the delta activity in EEG increased, alpha and beta activity decreased. And the delta activity decreased, the alpha and beta activity increased while diving during a dry condition. According to the diving and decompression procedure studied under simulated conditions, 272 person-times of diving training and underwater operations were processed in a high altitude hydroelectric power station at the altitude of 4442 meters, including photographing, video-recording,

measuring, and drilling. There were no signs and symptoms of decompression sickness and bubbles. PMID: 14519911 [PubMed - indexed for MEDLINE]

49: Wilderness Environ Med. 2003 Fall;14(3):191-2.

Comment on: Wilderness Environ Med. 2003 Fall;14(3):193.

Changes in body temperature and basal metabolic rate of the Ama--a commentary.

Glickman EL, Caine-Bish N.

Kent State University, Exercise Sciences Laboratory, Kent, OH 44242, USA.

Publication Types: Comment
Historical Article

PMID: 14518631 [PubMed - indexed for MEDLINE]

50: Blood Coagul Fibrinolysis. 2003 Oct;14(7):659-61.

Diving up to 60 m depth followed by decompression has no effect on pro-enzyme and total thrombin activatable fibrinolysis inhibitor antigen concentration.

Olszanski R, Radziwon P, Galar M, Klos R, Kloczko J.

Department of Maritime Medicine, Military Medical Academy, Gdynia, Poland.

The aim of our study was to investigate the effect of two different hyperbaric exposures followed by decompression on thrombin activatable fibrinolysis inhibitor (TAFI) concentration and activity. The hyperbaric conditions correspond to diving to 30 and 60 m water depth. Thirty-four male divers were tested in decompression habitat LSH-200, with air as a breathing medium. The pro-enzyme and total TAFI antigen concentration were measured. We did not observed significant changes of either pro-enzyme or total TAFI antigen concentration after both series of exposures followed by decompression. The results may suggest that TAFI plays only a marginal role, if any, in the regulation of induced fibrinolysis in divers, which may contribute to bleeding episodes in a course of decompression sickness.

PMID: 14517491 [PubMed - indexed for MEDLINE]

51: Acta Physiol Scand. 2003 Oct;179(2):167-72.

Muscle fibre size and capillarity in Korean diving women.

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AIM: Effects of prolonged habitual cold-water immersion on fibre size and capillarity in vastus lateralis muscle were studied in human beings. The hypothesis tested in the present study was that cold acclimatized human skeletal muscle would have reduced muscle fibre size and higher capillarity, favouring the idea of efficacy of recruitment under cold environment. METHODS: Ten women breath-hold divers (BHDs) and 10 active women (controls CONs) participated in this study. Muscle biopsy was obtained from vastus lateralis and determined fibre type composition and capillary density. RESULTS: A major finding was that all BHDs revealed a markedly smaller cross-sectional area (CSA) in all fibre types than the CONs, or even than any other morphological data reported in previous investigations. Furthermore, mean CSA of type II fibre (range 1205-2766 microm²) was much smaller than type I fibre (2343-4327 microm²). The number of capillaries per fibre in different fibre types in the BHDs was higher than in the CONs ($P < 0.001$), and diffusional area was smaller in type II fibres than in type I fibres ($P < 0.001$). The BHDs and the CONs have similarity in the percentage of type I fibres, but type II fibre was predominant in both groups. Interestingly the proportion of type IIX fibre in the BHDs was higher (31%) than in the CONs (22%). No significant difference was found in the thigh circumference between the groups. CONCLUSION: The present study demonstrates that prolonged habitual cold-water immersion may induce a decrease in fibre size and an increase in capillarity in human skeletal muscle.

PMID: 14510780 [PubMed - indexed for MEDLINE]

52: Anesthesiol Intensivmed Notfallmed Schmerzther. 2003 Oct;38(10):648-50.

[Lung edema in scuba diving]

[Article in German]

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The management of a diving-related emergency is frequently a great challenge for an emergency physician without a special diving medicine training or experiences. Almost every physician knows something about the medical therapy of diving-related accidents which are combined with a barotrauma or a decompression sickness. But there are still some rare symptoms and organ affections of diving-related emergencies which are unknown in common. In consideration of the present case of an acute diving-related lung edema we discuss the different reasons and differential diagnosis of diving emergencies.

Publication Types: Case Reports
PMID: 14508704 [PubMed - indexed for MEDLINE]

53: Aviat Space Environ Med. 2003 Sep;74(9):977-80.

Delayed-onset cerebral arterial gas embolism in a commercial airline mechanic.

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A commercial airline mechanic was evaluated for right-sided hemianesthesia. Thorough diagnostic testing failed to identify a definitive etiology, and the mechanic was assessed as having symptoms of a left internal capsule lesion, likely from an ischemic event. On day 12 after symptom onset, he consulted a diving medicine specialist for clearance to continue recreational scuba diving. A thorough history revealed that the patient worked regularly in a compressed air environment of commercial aircraft and had experienced a rapid decompression approximately 48 h prior to onset of the hemianesthesia. The specialist considered pulmonary barotrauma-induced cerebral arterial gas embolism as a possible diagnosis. On day 13 he was treated with hyperbaric oxygen using Treatment Table VI, which produced immediate relief. Following three additional hyperbaric oxygen treatments in the next 11 d, he reported nearly total resolution of his symptoms. This

occurrence is believed to be the second report of a cerebral arterial gas embolism in an aircraft mechanic or maintenance crewman and suggests that the latency between time of depressurization and the development of symptoms from a pulmonary barotrauma-induced cerebral arterial gas embolism may extend longer than previously believed.

Publication Types: Case Reports
PMID: 14503677 [PubMed - indexed for MEDLINE]

54: Otol Neurotol. 2003 Sep;24(5):723-7.

Does repeated hyperbaric exposure to 4 atmosphere absolute cause hearing impairment? Study in Guinea pigs and clinical incidences.

Meller R, Rostain JC, Luciano M, Chays A, Bruzzo M, Cazals Y, Magnan J.

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HYPOTHESIS: Direct pressure applied on the inner ear cannot induce hearing loss. **BACKGROUND:** Three possible causes have been described in the literature for inner ear permanent lesions during scuba diving: pressure imbalance between the middle ear and the external ear, appearance of microbubbles in the internal ear, and direct effect of pressure on the inner ear. We seek to determine whether this last factor can be involved. **METHODS:** We submitted two groups of guinea pigs previously implanted with an electrode in the round window to a protocol of air diving in a hyperbaric chamber. Eardrums of animals in one of the two groups had been perforated beforehand. Twenty dives were practiced over 4 weeks. We chose dive parameters consistent with common sport diving: maximal pressure of 4 atmosphere absolute and duration of 30 minutes. Auditory threshold and cochlear spontaneous activity were recorded at regular intervals. Furthermore, we recorded spontaneous cochlear activity in Heliox 400-m and 600-m dives to determine whether our conclusions hold for "extreme" diving. **RESULTS:** In the group with perforated eardrums, no variation of those parameters were recorded, even in extreme diving. Important variations were noticed in the other group.

CONCLUSIONS: Pressure applied directly on the inner ear during diving does not disturb cochlear activity.

PMID: 14501446 [PubMed - indexed for MEDLINE]

55: Lancet. 2003 Sep 13;362(9387):846.

Faster, higher, stronger...and deeper?

Sharp D.

The Lancet, 32 Jamestown Road, NW1 7BY, London, UK.

PMID: 13678969 [PubMed - indexed for MEDLINE]

56: Physiol Biochem Zool. 2003 Jul-Aug;76(4):436-46.

The influence of oxygen and carbon dioxide on diving behaviour of tufted ducks, *Aythya fuligula*.

Halsey L, Reed JZ, Woakes A, Butler P.

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While optimal diving models focus on the diver's oxygen (O₂) stores as the predominant factor influencing diving behaviour, many vertebrate species surface from a dive before these stores are exhausted and may commence another dive well after their O₂ stores have been resaturated. This study investigates the influence of hypoxia and also hypercapnia on the dive cycle of tufted ducks, *Aythya fuligula*, in terms of surface duration and dive duration. The birds were trained to surface into a respirometer box after each dive to a feeding tray so that rates of O₂ uptake (VO₂) and carbon dioxide output (VCO₂) at the surface could be measured. Although Vco₂ initially lagged behind Vo₂, both respiratory gas stores were close to full adjustment after the average surface duration, indicating that they probably had a similar degree of influence on surface duration. Chemoreceptors, which are known to influence diving behaviour, detect changes in O₂ and CO₂ partial pressures in the arterial blood. Thus, the need to restore blood gas levels appears to be a strong stimulus to continue ventilation. Mean surface duration coincided with peak instantaneous respiratory exchange ratio due to prediving anticipatory

hyperventilation causing hypocapnia. For comparison, the relationship between surface duration and O₂ uptake in reanalysed data for two grey seals indicated that one animal tended to dive well after fully restocking its O₂ stores, while the other dived at the point of full restocking. More CO₂ is exchanged than O₂ in tufted ducks during the last few breaths before the first dive of a bout, serving to reduce CO₂ stores and suggesting that hypercapnia rather than hypoxia is more often the limiting factor on asphyxia tolerance during dives. Indeed, according to calculations of O₂ stores and O₂ consumption rates over modal diving durations, a lack of O₂ does not seem to be associated with the termination of a dive in tufted ducks. However, factors other than CO₂ are also likely to be important, and perhaps more so, such as food density and rate of food ingestion. Because some predictive success has been demonstrated for optimal diving models, they should continue to incorporate O₂ stores as a variable, but their validity is likely to be improved by also focusing on CO₂ stores.
PMID: 13130424 [PubMed - indexed for MEDLINE]

57: Swiss Surg. 2003;9(4):181-3.
[Intestinal barotrauma after diving-mechanical ileus in incarceration of the last loop of the small intestine between a mobile cecum and sigmoid]
[Article in French]
Haller C, Guenot C, Azagury D, Rosso R.
Ensemble hospitalier de la Cote, Hopital de Morges, service de chirurgie, Morges.
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A few hours after a self-contained underwater breathing apparatus (SCUBA) dive at 30 meters depth, a 49 years-old man complained of diffuse abdominal pain with nausea and vomitus. A laparotomy was performed 36 hours after a conservative treatment because of persistent mechanical small bowel obstruction. The last ileal loop was strangulated between a mobile caecum and a long sigmoid loop. The man never had previous abdominal surgery. In absence of intestinal

necrosis, a caecopexy was done and there was no post-operative complications. The gas distension during the ascension following the Boyle-Mariotte law and its distribution induced in this man with a special anatomy a mechanical small bowel obstruction. The treatment of mobile caecum and the literature of abdominal barotrauma is reviewed.
PMID: 12974175 [PubMed - indexed for MEDLINE]

58: Med Sci Sports Exerc. 2003 Sep;35(9):1493-8.
Airway reactivity and diving in healthy and atopic subjects.
Cirillo I, Vizzaccaro A, Crimi E.
Respiratory Physiopathology, Bronchology, Allergy and Immunology Clinic, Italian Navy Hospital Bruno Falcomata, La Spezia, Italy.
BACKGROUND: The short- and long-term effects of self-contained underwater breathing apparatus (SCUBA) dives on airway responsiveness in nonasthmatic atopic subjects have not been systematically investigated. PURPOSE: To compare the effect of SCUBA diving at 50-m depth on lung function and airway responsiveness to methacholine (MCh) in atopic nonasthmatics and healthy subjects. METHODS: We studied 15 atopic nonasthmatic subjects and 15 controls who underwent the visit for the professional SCUBA-diving license at the Navy Medical Center, La Spezia, Italy. All subjects underwent spirometry and skin-prick test for common environmental allergens. MCh challenge was performed 24 h before, and 20 min and 24 h after a standardized SCUBA-dive test and after hyperbaric-chamber test. RESULTS: At 20 min, the provocative dose of MCh causing 20% fall of the forced expiratory volume at the first second (MCh PD₂₀ - FEV₁) was significantly reduced in atopic, asymptomatic subjects from 1712 x 2.6 microg (mean x geometric standard deviation) to 1202 x 2.2 microg (P < 0.0005) after the hyperbaric-chamber test and to 1204 x 2.3 microg (P < 0.005) after SCUBA diving. In healthy subjects, the baseline value of MCh PD₂₀ was 2977 x 1.1 microg, and this value did not change significantly after the hyperbaric-chamber test (2575 x 1.4 microg) and after SCUBA dives (2553

x 1.4 microg, $P > 0.1$ for both comparisons). In atopic subjects, the MCh PD20 returned near to the baseline value 24 h after the hyperbaric-chamber test (1776 x 2.4 microg) and after the SCUBA test (1500 x 2.67 microg). No significant change in FEV1 was observed after the tests in both groups. CONCLUSION: SCUBA diving is associated with development of early airway hyperresponsiveness to MCh in atopic subjects. PMID: 12972867 [PubMed - indexed for MEDLINE]

59: Undersea Hyperb Med. 2003 Summer;30(2):155-62. Navy hearing conservation program: hearing threshold comparisons to Navy SEALs and divers. Bohnker B, Rovig G, Page J, Philippi A, Butler F, Sack D. Navy Environmental Health Center, 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 23708, USA. The study examined hearing threshold for Navy special operations personnel (SEALs (Sea-Air-Land): $N = 212$; divers: $N = 165$). Hearing threshold values were obtained and age adjusted using Mantel Haenzel Weighted odds ratio (MHOR) to compare with information in the Navy Hearing Conservation Database. For any threshold above 20 dB in the 500 through 3000 Hz range, the SEALs were significantly less at risk (MHOR = 0.54, $p = 0.022$) in the right ear, while the divers were significantly less at risk in the left ear (MHOR = 0.61, $p = 0.047$). For hearing thresholds at 4000 Hz above 40 dB, SEALs were significantly more at risk in both left ear (MHOR = 2.03, $p = 0.0043$) and right ear (MHOR = 2.58, $p = 0.000089$), while divers were not different. Risk assessment based on these findings must consider the multiple exposure hazards and critical mission profiles for the Navy special operations personnel. Requirements for mission accomplishment in hazardous environments may deem these risks acceptable. PMID: 12964859 [PubMed - indexed for MEDLINE]

60: Undersea Hyperb Med. 2003 Summer;30(2):93-102.

Incidence and risk factors for symptoms of decompression sickness among male and female dive masters and instructors--a retrospective cohort study.

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The aim was to determine the incidence of symptoms of decompression sickness (DCS) in dive masters and instructors in relation to number of dives and possible risk factors. STUDY DESIGN: Retrospective cohort study of dive masters and instructors in Sweden. STUDY BASE: All dive masters and instructors listed with PADI, NAUI and CMAS in Sweden as of January 1st 1999 (2380 divers). METHODS: The dive masters and instructors received a validated questionnaire on diving activities and symptoms of DCS in 1999. 1516 men and 226 women answered, i.e. 73% of the initial study base. RESULTS: DCS symptoms were reported by 190 divers. The incidence of DCS symptoms was 1.52 for males and 1.27 for females per 1000 dives. Dive masters, divers not performing decompression-stop dives, divers not practicing advanced diving and divers with a low number of total lifetime dives had a higher proportion ($p < 0.05$) of DCS symptoms per 1000 dives. There were no major differences in DCS symptom incidence related to sex, age, asthma, overweight or alcohol abuse in this study.

PMID: 12964853 [PubMed - indexed for MEDLINE]

61: Eur J Appl Physiol. 2003 Oct;90(3-4):377-86. Epub 2003 Sep 2. Energy balance of human locomotion in water.

Pendergast D, Zamparo P, di Prampero PE, Capelli C, Cerretelli P, Termin A, Craig A Jr, Bushnell D, Paschke D, Mollendorf J.

Department of Physiology, University at Buffalo, 124 Sherman Hall, Buffalo, NY 14214, USA.

In this paper a complete energy balance for water locomotion is attempted with the aim of comparing different modes of transport in the aquatic environment (swimming

underwater with SCUBA diving equipment, swimming at the surface: leg kicking and front crawl, kayaking and rowing). On the basis of the values of metabolic power (E), of the power needed to overcome water resistance (W_d) and of propelling efficiency ($\eta_P = W_d/W_{tot}$, where W_{tot} is the total mechanical power) as reported in the literature for each of these forms of locomotion, the energy cost per unit distance ($C = E/v$, where v is the velocity), the drag (performance) efficiency ($\eta_d = W_d/E$) and the overall efficiency ($\eta_o = W_{tot}/E = \eta_d/\eta_P$) were calculated. As previously found for human locomotion on land, for a given metabolic power (e.g. $0.5 \text{ kW} = 1.43 \text{ l}\cdot\text{min}^{-1} \text{ VO}_2$) the decrease in C (from $0.88 \text{ kJ}\cdot\text{m}^{-1}$ in SCUBA diving to $0.22 \text{ kJ}\cdot\text{m}^{-1}$ in rowing) is associated with an increase in the speed of locomotion (from $0.6 \text{ m}\cdot\text{s}^{-1}$ in SCUBA diving to $2.4 \text{ m}\cdot\text{s}^{-1}$ in rowing). At variance with locomotion on land, however, the decrease in C is associated with an increase, rather than a decrease, of the total mechanical work per unit distance (W_{tot} , $\text{kJ}\cdot\text{m}^{-1}$). This is made possible by the increase of the overall efficiency of locomotion ($\eta_o = W_{tot}/E = W_{tot}/C$) from the slow speeds (and loads) of swimming to the high speeds (and loads) attainable with hulls and boats (from 0.10 in SCUBA diving to 0.29 in rowing).
PMID: 12955519 [PubMed - indexed for MEDLINE]

62: Environ Health Perspect. 2003 Sep;111(12):A630; author reply A630-1.
Comment on: Environ Health Perspect. 2003 Apr;111(4):609-17.
Cancer risk to naval divers questioned.
Amitai Y, Almog S, Herut B.
Publication Types: Comment Letter
PMID: 12948902 [PubMed - indexed for MEDLINE]

63: J Sci Med Sport. 2003 Jun;6(2):155-65.
Retention of safe diving skills.
Blitvich JD, McElroy GK, Blanksby BA, Parler HE.
University of Ballarat, Ballarat, Victoria, Australia.

This study investigated diving skill maintenance over an eight-month retention period following an intervention program. Thirty-four recreational swimmers with poor diving skills were measured before and immediately after a diving skills intervention program. Twenty-two returned for follow-up evaluation. Treadwater, Deck and Block dives were video-recorded, and maximum depth, distance, velocity, entry angle and flight distance were compared. Underwater hand and arm positions were examined. Pre-intervention, a breaststroke arm action before maximum depth occurred in 18% of all dives and 38% of Treadwater dives. This was eliminated post-intervention, improving head protection. The Treadwater dive elicited the greatest mean maximum depth, and ANOVA showed depth for this entry decreased (improved) following intervention and remained shallower at follow-up. Deck and Block dives also became shallower following intervention. As seven 10-minute skills sessions resulted in shallower dives with safer hand and arm positions, including safe diving skills in learn-to-swim programs can provide a diving spinal cord injury prevention strategy.
PMID: 12945622 [PubMed - indexed for MEDLINE]

64: Eur J Appl Physiol. 2003 Oct;90(3-4):292-304. Epub 2003 Aug 27.
Cardiac output: a view from Buffalo. Olszowka AJ, Shykoff BE, Pendergast DR, Lundgren CE, Farhi LE.
The Herman Rahn Laboratory, Department of Physiology and Biophysics and the Center for Research and Education in Special Environment, University at Buffalo, Buffalo, New York, USA.
Cardiac output (Q) is a primary determinant of blood pressure and O_2 delivery and is critical in the maintenance of homeostasis, particularly during environmental stress. Cardiac output can be determined invasively in patients; however, indirect methods are required for other situations. Soluble gas techniques are widely used to determine Q . Historically, measurements during a breathhold, prolonged expiration and rebreathing

to CO₂ equilibrium have been used; however, with limitations, especially during stress. Farhi and co-workers developed a single-step CO₂ rebreathing method, which was subsequently revised by his group, and has been shown to be valid (compared to direct measures) and reliable. Carbon dioxide output (VCO₂), partial pressure of arterial CO₂ (PaCO₂), and partial pressure of mixed venous CO₂ (Pv(CO₂)) are determined during 12-25 s of rebreathing, using the appropriate tidal volume, and Q is calculated. This method has the utility to provide accurate data in laboratory and field experiments during exercise, increased and micro-gravity, water immersion, lower body pressure, head-down tilt, and changes in gas composition and pressure. Utilizing the Buffalo CO₂ rebreathing method it has been shown that the Q can adjust to a wide range of changes in environments maintaining blood pressure and O₂ delivery at rest and during exercise.

Publication Types: Review
Review, Tutorial
PMID: 12942332 [PubMed - indexed for MEDLINE]

65: J Exp Biol. 2003 Oct;206(Pt 19):3405-23.

Blubber and buoyancy: monitoring the body condition of free-ranging seals using simple dive characteristics.

Biuw M, McConnell B, Bradshaw CJ, Burton H, Fedak M.

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Elephant seals regularly perform dives during which they spend a large proportion of time drifting passively through the water column. The rate of vertical change in depth during these "drift" dives is largely a result of the proportion of lipid tissue in the body, with fatter seals having higher (more positive or less negative) drift rates compared with leaner seals. We examined the temporal changes in drift rates of 24 newly weaned southern elephant seal (*Mirounga leonina*) pups during their first trip to sea to determine if this easily recorded dive characteristic can be used to continuously monitor

changes in body composition of seals throughout their foraging trips. All seals demonstrated a similar trend over time: drift rates were initially positive but decreased steadily over the first 30-50 days after departure (Phase 1), corresponding to seals becoming gradually less buoyant. Over the following approximately 100 days (Phase 2), drift rates again increased gradually, while during the last approximately 20-45 days (Phase 3) drift rates either remained constant or decreased slightly. The daily rate of change in drift rate was negatively related to the daily rate of horizontal displacement (daily travel rate), and daily travel rates of more than approximately 80 km were almost exclusively associated with negative changes in drift rate. We developed a mechanistic model based on body compositions and morphometrics measured in the field, published values for the density of seawater and various body components, and values of drag coefficients for objects of different shapes. We used this model to examine the theoretical relationships between drift rate and body composition and carried out a sensitivity analysis to quantify errors and biases caused by varying model parameters. While variations in seawater density and uncertainties in estimated body surface area and volume are unlikely to result in errors in estimated lipid content of more than +/-2.5%, variations in drag coefficient can lead to errors of >or =10%. Finally, we compared the lipid contents predicted by our model with the lipid contents measured using isotopically labelled water and found a strong positive correlation. The best-fitting model suggests that the drag coefficient of seals while drifting passively is between approximately 0.49 (roughly corresponding to a sphere-shaped object) and 0.69 (a prolate spheroid), and we were able to estimate relative lipid content to within approximately +/-2% lipid. Our results suggest that this simple method can be used to estimate the changes in lipid content of free-ranging seals while at sea and may help improve our understanding of

the foraging strategies of these important marine predators.
PMID: 12939372 [PubMed - indexed for MEDLINE]

66: Brain Res. 2003 Sep 12;984(1-2):42-53.
Activation of brainstem catecholaminergic neurons during voluntary diving in rats.
McCulloch PF, Panneton WM.
Department of Physiology, Midwestern University, 555 31st Street, Downers Grove, IL 60515, USA.
pmccul@midwestern.edu
Underwater submergence produces a complex autonomic response that includes apnea, a parasympathetically-mediated bradycardia, and a sympathetically-mediated increase in total peripheral resistance (TPR). The present study was designed to identify brainstem catecholaminergic neurons that may be involved in producing the increased TPR during underwater submergence. Twelve male Sprague-Dawley rats were trained to voluntarily dive 5 m through an underwater maze. On the day of the experiment the rats were randomly separated into a Diving group that repetitively dived underwater, a Swimming group that repetitively swam on the surface of the water, and a Control group that remained in their cages. After the experiment the brainstems of the rats were immunohistologically processed for Fos as an indicator of neuronal activation, and for tyrosine hydroxylase (TH) as an identifier of catecholaminergic neurons. Neurons labeled with both Fos and TH identified activated catecholaminergic neurons. In Diving rats there was increased Fos+TH labeling in A1, C1, A2, A5, and sub-coeruleus, as well as globosa neurons in the lateral A7 region compared with Control rats, and in A1, C1 and A5 compared with Swimming rats. In Swimming rats Fos+TH labeling was significantly increased in caudal A1, A5, sub-coeruleus and globosa neurons compared with Control rats. These data suggest that selective groups of catecholaminergic neurons within the brainstem are activated by voluntary underwater submergence, and some probably contribute to the

sympathetically-mediated increase in vascular tone during diving.
PMID: 12932838 [PubMed - indexed for MEDLINE]

67: Adv Physiol Educ. 2003 Dec;27(1-4):130-45.
Simulated human diving and heart rate: making the most of the diving response as a laboratory exercise.
Hiebert SM, Burch E.
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Laboratory exercises in which students examine the human diving response are widely used in high school and college biology courses despite the experience of some instructors that the response is unreliably produced in the classroom. Our experience with this exercise demonstrates that the bradycardia associated with the diving response is a robust effect that can easily be measured by students without any sophisticated measurement technology. We discuss measures that maximize the success of the exercise by reducing individual variation, designing experiments that are minimally affected by change in the response over time, collecting data in appropriate time increments, and applying the most powerful statistical analysis. Emphasis is placed on pedagogical opportunities for using this exercise to teach general principles of physiology, experimental design, and data analysis. Data collected by students, background information for instructors, a discussion of the relevance of the diving reflex to humans, suggestions for additional experiments, and thought questions with sample answers are included.
Publication Types: Evaluation Studies
PMID: 12928322 [PubMed - indexed for MEDLINE]

68: Physiol Biochem Zool. 2003 May-Jun;76(3):375-88.
Variation in energy expenditure among black-legged kittiwakes: effects of activity-specific metabolic rates and activity budgets.
Jodice PG, Roby DD, Suryan RM, Irons DB, Kaufman AM, Turco KR, Visser GH.

U.S. Geological Survey, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon 97331, USA.

We sought to determine the effect of variation in time-activity budgets (TABs) and foraging behavior on energy expenditure rates of parent black-legged kittiwakes (*Rissa tridactyla*). We quantified TABs using direct observations of radio-tagged adults and simultaneously measured field metabolic rates (FMR) of these same individuals (n=20) using the doubly labeled water technique. Estimated metabolic rates of kittiwakes attending their brood at the nest or loafing near the colony were similar (ca. 1.3 x basal metabolic rate [BMR]), although loafing during foraging trips was more costly (2.9 x BMR). Metabolic rates during commuting flight (7.3 x BMR) and prey-searching flight (6.2 x BMR) were similar, while metabolic rates during plunge diving were much higher (ca. 47 x BMR). The proportion of the measurement interval spent foraging had a positive effect on FMR (R²=0.68), while the combined proportion of time engaged in nest attendance and loafing near the colony had a negative effect on FMR (R²=0.72). Thus, more than two-thirds of the variation in kittiwake FMR could be explained by the allocation of time among various activities. The high energetic cost of plunge diving relative to straight flight and searching flight suggests that kittiwakes can optimize their foraging strategy under conditions of low food availability by commuting long distances to feed in areas where gross foraging efficiency is high.

PMID: 12905124 [PubMed - indexed for MEDLINE]

69: Laryngoscope. 2003 Aug;113(8):1356-61.

Comment in: Laryngoscope. 2004 Aug;114(8):1510; author reply 1510-1.

Embolic inner ear decompression illness: correlation with a right-to-left shunt.

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OBJECTIVES/HYPOTHESIS: Inner ear decompression illness is thought to be a rare phenomenon in recreational divers, isolated signs and symptoms of inner ear dysfunction usually being attributed to inner ear barotrauma. STUDY DESIGN: We present 11 cases of inner ear dysfunction in nine divers with inner ear decompression illness. RESULTS: All nine divers had significant right-to-left shunt as diagnosed by transcranial Doppler sonography. CONCLUSIONS: The authors thought that mechanism of causation in these cases may have been intravascular bubble emboli and that inner ear decompression illness may be more common among recreational divers than currently recognized. Failure to treat inner ear decompression illness with recompression therapy can result in permanent disability. Because the differential diagnosis between inner ear barotrauma and inner ear decompression illness can be impossible, the authors suggested that divers who present with inner ear symptoms following a dive should have recompression immediately after having undergone bilateral paracentesis.

PMID: 12897559 [PubMed - indexed for MEDLINE]

70: Occup Environ Med. 2003 Aug;60(8):606-8.

Should computed chest tomography be recommended in the medical certification of professional divers? A report of three cases with pulmonary air cysts.

Toklu AS, Kiyani E, Aktas S, Cimsit M.

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Pulmonary barotrauma (PBT) is a recognised risk of compressed gas diving. Any reason that causes air trapping in the lung during ascent may cause PBT by increasing intrapulmonary pressure. Chest x ray examination is mandatory for medical certification of the professional divers in many countries, but pulmonary air trapping lesions such

as an air cyst in the lungs cannot always be detected by plain chest x ray examination. Computed tomography (CT) is a reliable, but expensive measure for detecting pulmonary abnormalities in divers. Three cases with pulmonary air cysts are reported in which air cysts were invisible on the x ray pictures, but well defined by CT. It is impractical and not cost effective to perform CT for medical certification of all divers, but it can be an option to recommend CT once during the initial examination of the candidates for professional diving, especially if there is a history of predisposing factors, such as smoking or pulmonary infections.

Publication Types: Case Reports
PMID: 12883024 [PubMed - indexed for MEDLINE]

71: BMJ. 2003 Jul 19;327(7407):s21.
Diving doctor.
Wheeler D.
PMID: 12869485 [PubMed - indexed for MEDLINE]

72: J Ark Med Soc. 2003 Apr;99(10):327-30.
Sensorineural hearing loss as the result of cliff jumping.
Hardin MF, Barker M, Neis PR.
A case of unilateral, sudden sensorineural hearing loss and possible perilymphatic fistula as the result of cliff jumping into water is presented. The physiological mechanisms contributing to such a barotraumatic auditory injury are described. A conservative treatment protocol is reviewed as well as documented hearing recovery.
Publication Types: Case Reports
PMID: 12868136 [PubMed - indexed for MEDLINE]

73: Aviat Space Environ Med. 2003 Jul;74(7):763-7.
Improved pulmonary function in working divers breathing nitrox at shallow depths.
Fitzpatrick DT, Conkin J.
Sonny Carter Training Facility, Neutral Buoyancy Laboratory, NASA-Johnson Space Center, Houston, TX 77058-3696, USA.
daniel.t.fitzpatrick1@jsc.nasa.gov
INTRODUCTION: There is limited data about the long-term pulmonary

effects of nitrox use in divers at shallow depths. This study examined changes in pulmonary function in a cohort of working divers breathing a 46% oxygen enriched mixture while diving at depths less than 12 m.
METHODS: A total of 43 working divers from the Neutral Buoyancy Laboratory (NBL), NASA-Johnson Space Center completed a questionnaire providing information on diving history prior to NBL employment, diving history outside the NBL since employment, and smoking history. Cumulative dive hours were obtained from the NBL dive-time database. Medical records were reviewed to obtain the diver's height, weight, and pulmonary function measurements from initial pre-dive, first year and third year annual medical examinations. RESULTS: The initial forced vital capacity (FVC) and forced expiratory volume in 1 s (FEV1) were greater than predicted, 104% and 102%, respectively. After 3 yr of diving at the NBL, both the FVC and FEV1 showed a significant ($p < 0.01$) increase of 6.3% and 5.5%, respectively. There were no significant changes in peak expiratory flow (PEF), forced mid-expiratory flow rate (FEF(25-75%)), and forced expiratory flow rates at 25%, 50%, and 75% of FVC expired (FEF25%, FEF50%, FEF75%). Cumulative NBL dive hours was the only contributing variable found to be significantly associated with both FVC and FEV1 at 1 and 3 yr. CONCLUSIONS: NBL divers initially belong to a select group with larger than predicted lung volumes. Regular diving with nitrox at shallow depths over a 3-yr period did not impair pulmonary function. Improvements in FVC and FEV1 were primarily due to a training effect.

Publication Types: Evaluation Studies
PMID: 12862332 [PubMed - indexed for MEDLINE]

74: Clin Sports Med. 2003 Jul;22(3):501-12.
Acute sports-related spinal cord injury: contemporary management principles.
Kim DH, Vaccaro AR, Berta SC.
Department of Orthopaedic Surgery, Thomas Jefferson University, 925 Chestnut Street, Philadelphia, PA, 19107-1216, USA.

Improvements in helmet and equipment design have led to significant decreases in overall injury incidence, but no available helmet can prevent catastrophic injury to the neck and cervical spine. The most effective strategy for preventing this type of injury appears to be careful instruction, training, and regulations designed to eliminate head-first contact. The incidence of football-related quadriplegia has decreased from a peak of 13 cases per one million players between 1976 and 1980 to 3 per million from 1991 to 1993, mostly as a result of systematic research and an organized effort to eliminate high-risk behavior. An episode of transient quadriparesis does not appear to be a risk factor for catastrophic spinal cord injury. Torg reported that 0 of 117 quadriplegics in the National Football Head and Neck Injuries Registry recalled a prior episode of transient quadriparesis, and 0 of the 45 patients originally studied in his transient quadriparesis cohort have subsequently suffered quadriplegia. The significance of developmental spinal stenosis is unclear. Plain radiographic identification of a narrow spinal canal in a player sustaining cervical cord neurapraxia warrants further evaluation by MRI to rule out functional stenosis. The presence of actual cord deformation or compression on MRI should preclude participation in high-risk contact or collision sports.

Publication Types: Review
Review, Tutorial

PMID: 12852683 [PubMed - indexed for MEDLINE]

75: Crit Care Med. 2003 Jul;31(7):2083.

Comment on: Crit Care Med. 2003 Jan;31(1):84-8.

Right-to-left shunts and risk of decompression illness.

Tetzlaff K, Muth CM.

Publication Types: Comment
Letter

PMID: 12847414 [PubMed - indexed for MEDLINE]

76: Fiziol Cheloveka. 2003 May-Jun;29(3):104-9.

[Prognostic values of different psychophysiological criteria for selection of athletes-divers]

[Article in Russian]

Erogina MA, Maloletnev VI, Biriukova IE.

PMID: 12845790 [PubMed - indexed for MEDLINE]

77: Eur J Appl Physiol. 2003 Oct;90(3-4):387-95. Epub 2003 Jul 4. Locomotor behaviours and respiratory pattern of the Mediterranean fin whale (*Balaenoptera physalus*).

Lafortuna CL, Jahoda M, Azzellino A, Saibene F, Colombini A.

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Twenty-four Mediterranean fin whales were tracked in open sea with a method based on the assessment of the animal differential position in respect of the observer's absolute position aboard a vessel, with the concomitant recording of the respiratory activity. Short distance video recording was also performed in two whales, permitting the simultaneous determination of single breath expiratory (TE) and inspiratory (TI) durations. In the 24 whales swimming at an average velocity of 1.39 (0.47) m.s(-1) [mean (SD), range: 0.62-2.44 m.s(-1)], 2068 breaths organized in 477 respiratory cycles were observed. Each cycle entailed a prolonged apnoea dive phase [225 (91) s, Tdive) followed by a period near the surface [62 (28) s, surfacing], during which a series of breaths [4.6 (1.8)] was performed at short intervals. On the basis of track length and swimming velocity, two groups of animals were devised differing for convolution of the course (p<0.001), extension of ranging territory (p<0.01) and horizontal swimming velocity (p<0.05), which may represent two distinct behaviours. A possibly general mechanism of control of breathing in cetaceans was found, consistent with a model of constant tidal volume and variable respiratory frequency. Coherently with this model, TE was independent of TI or Tdive, in line with a passive expiration, while TI appeared to be negatively correlated

with Tdive ($p < 0.05$), otherwise suggesting, similarly with terrestrial mammals, a significant role of hypercapnic stimulation. The estimated O_2 consumption of about $150 \text{ l} \cdot \text{min}^{-1}$ is in line with the general allometric regression for mammals and corresponds to an energetic expenditure of $85\text{-}95 \text{ kJ} \cdot \text{kg}^{-1} \cdot \text{day}^{-1}$.
PMID: 12845537 [PubMed - indexed for MEDLINE]

78: Undersea Hyperb Med. 2003 Spring;30(1):75-85.
Underwater fin swimming in women with reference to fin selection. Pendergast DR, Mollendorf J, Logue C, Samimy S.
Center for Research and Education in Special Environments, School of Engineering, University at Buffalo, Buffalo, NY 14214, USA.
Underwater swimmers use fins, which provide thrust to overcome drag and propel the diver. The type of fin used has been shown to affect diver performance, however data are lacking for women. The oxygen consumption ($V_{dot{O}_2}$) of swimming as a function of speed, velocity as a function of kick frequency, maximal speed (v), maximal $V_{dot{O}_2}$ and the maximal thrust were determined for 8 female divers swimming at 1.25 m depth in a 60 m annular pool. $V_{dot{O}_2}$ increased as a function of v as; $0.52 + -0.485 V + 2.85 V^2$ ($r^2 = 0.996$) and $0.12 + 1.52 V + 1.275 V^2$ ($r^2 = 0.999$) for high (5 fins) and low (3 fins) groupings, respectively. Splits, vents and flanges did not significantly affect $V_{dot{O}_2}$. Kick frequency increased linearly with v , with unique slopes for each fin. Maximal $V_{dot{O}_2}$ was not affected by fin type ($1.46 \pm 0.05 \text{ l/min}$). Velocities that could be sustained aerobically were $0.60 \pm 0.02 \text{ m/sec}$ on average, with the most flexible fin higher (0.71 m/sec). Maximal v averaged $0.87 \pm 0.03 \text{ m/sec}$, with the most rigid fin lower (0.77 m/sec). Maximal thrust was not affected by fin and averaged $104 \pm 9 \text{ N}$. It can be concluded that female divers preferred the most flexible fins, which were also the most economical. This is most likely due to low leg power, which could also explain the absence of differences in maximal thrust and velocity.

Publication Types: Evaluation Studies
PMID: 12841610 [PubMed - indexed for MEDLINE]

79: Undersea Hyperb Med. 2003 Spring;30(1):57-73.
Evaluation of fins used in underwater swimming. Pendergast DR, Mollendorf J, Logue C, Samimy S.
Center for Research and Education in Special Environments, School of Engineering, University at Buffalo, Buffalo, NY 14214, USA.
Underwater swimmers use fins which augment thrust to overcome drag and propel the diver. The $V_{dot{O}_2}$ of swimming as a function of speed, velocity as a function of kick frequency, maximal speed (v), maximal oxygen consumption ($V_{dot{O}_2}$) and the maximal thrust were determined for eight fins in 10 male divers swimming at 1.25 m depth in a 60 m annular pool. A theoretical analysis of fin cycles was also performed. $V_{dot{O}_2}$ increased as a second order polynomial as a function of velocity; $V_{dot{O}_2} = 0.045 + 1.65B V + 1.66 (2) V^2$ ($r^2 = 0.997$), $V_{dot{O}_2} = 0.25 + 1.03 V + 1.83 V^2$ ($r^2 = 0.997$) and $V_{dot{O}_2} = -0.15 + 2.26 V + 1.49 V^2$ ($r^2 = 0.997$), for least, average and most economical fins respectively. Kick frequency increased linearly with velocity and had a unique movement path (signature), giving theoretical values that agreed with the measured thrust, drag and efficiency. In conclusion, virtually all thrust comes from the downward power stroke, with rigid fins kicked deep (high drag), while flexible fins are kicked less deep but with higher frequency (low efficiency). Kick depth and frequency explain the performance of the eight tested fins, and should be optimized to enhance diver performance.
Publication Types: Evaluation Studies
PMID: 12841609 [PubMed - indexed for MEDLINE]

80: Undersea Hyperb Med. 2003 Spring;30(1):47-55.
Autonomic nervous activity and stress hormones induced by hyperbaric saturation diving. Hirayanagi K, Nakabayashi K, Okonogi K, Ohiwa H.

Department of Hygiene and Space Medicine, Nihon University School of Medicine, Itabashi-ku, Tokyo 173-8610, Japan.

This study describes the changes in autonomic nervous activity and stress hormones during a hyperbaric saturation dive up to 4.1 MPa in six subjects. Their autonomic nervous activity was assessed by a power spectrum analysis of heart rate variability (HRV). The levels of plasma epinephrine (E) and norepinephrine (NE), and those of salivary chromogranin A and cortisol, were compared with the pre-dive control levels. Restrained activity of the cardiac vagal nerve was recognized in the early post-dive period by a decrease in high frequency power and by the standard deviation of the HRV. By contrast, enhanced activity of sympathetic nerve was recognized in the early post-dive period by an elevated plasma E, and also in the late 3.1 MPa, 4.1 MPa, and post-dive periods by elevated plasma NE. The levels of plasma E and NE were the most sensitive indicators of sympathetic nervous activity. A joint utilization of HRV parameters with stress hormones may be an effective means of estimating the adaptive responses between hyperbaric and normobaric environments.

PMID: 12841608 [PubMed - indexed for MEDLINE]

81: Undersea Hyperb Med. 2003 Spring;30(1):29-36.

Instantaneous beat-to-beat variability reflects vagal tone during hyperbaric hyperoxia.

Lund V, Laine J, Laitio T, Kentala E, Jalonen J, Scheinin H.

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Hyperbaric hyperoxia affects heart rate variability (HRV) by increasing parasympathetic activity. The purpose of this study was to evaluate the applicability of instantaneous beat-to-beat variability (SD1 of Poincare plot analysis) in detecting changes in vagal tone and to evaluate possible changes in the fractality of heart rate dynamics (alpha1 of detrended fluctuation analysis) during hyperbaric hyperoxia. Continuous three-lead ECG recordings were taken

in ten divers who were treated at 2.5 ATA with air (PO2 47 kPa) and oxygen (PO2 235 kPa) for 60 min. Power spectral analysis, Poincare plot analysis and alpha1 were analyzed before compression, after 30 min and after 55 min at 2.5 ATA. Correlations between the variables were calculated after 55 min exposure. SD1 and high frequency (HF) power increased significantly but alpha1 decreased during hyperbaric hyperoxia (PO2 235 kPa). HF power and SD1 also correlated significantly. However, HF power and SD1 correlated inversely with alpha1. During hyperbaric hyperoxia, SD1 reflects vagal activity and can be used instead of HF power, if stationary conditions cannot be achieved. The decreasing alpha1 indicates more random heart rate dynamics during hyperbaric hyperoxia.

PMID: 12841606 [PubMed - indexed for MEDLINE]

82: Undersea Hyperb Med. 2003 Spring;30(1):19-27.

Noninvasive myocardial contractility monitoring with seismocardiography during simulated dives.

Koch A, McCormack P, Schwanecke A, Schnoor P, Buslaps C, Tetzlaff K, Rieckert H.

German Naval Medical Institute, Kopperpahler Allee 120, 24119 Kronshagen, Germany.

OBJECTIVE: To determine if bradycardia during hyperbaric exposure is accompanied by a negative influence on myocardial contractility. METHODS:

Accelerometer-based registration of myocardial compression waves with Seismocardiography (SCG) for noninvasive contractility monitoring. Comparative pulmonary artery (PA) catheter study (9 ICU-patients, mean = 67ys) with ejection-fraction (EF) equivalent versus sum of g-values of contraction phase in SCG, and Preload (leg-positioning). Test with monitoring of changes in Contractility Index (ContrI) derived from the SCG-power spectrum (contraction phases, area under curve). Hyperbaric chamber study (0.6MPa dive-simulation) in 14 healthy divers. Quantitative SCG-(ContrI, power spectra) and ECG-recording. RESULTS: Correlation

between changes in EF (PA catheter) and in the g-values (SCG) was $r(SP) = 0.87$ ($p < 0.0001$). ContrI increased in the leg-positioning test parallel to preload increase, heart rate remained stable. During hyperbaric exposure (0.6MPa) heart rate decrease was highly significant (68 to 58 min(-1); $p < 0.001$), ContrI and power spectra remained nearly unchanged, SCG registration was noise free. CONCLUSIONS: Hyperoxic bradycardia during simulated dives is not accompanied by impaired contractility measured with SCG, which is concordant to findings with invasive methods in current literature. SCG is suitable for noninvasive and stress free contractility monitoring and patient surveillance in a hyperbaric chamber.
PMID: 12841605 [PubMed - indexed for MEDLINE]

83: Med Monatsschr Pharm. 2003 Jun;26(6):188-94.
[The dangers of swimming and diving]
[Article in German]
Wantzen J.
Publication Types: Review
Review, Tutorial
PMID: 12840954 [PubMed - indexed for MEDLINE]

84: Emerg Med J. 2003 Jul;20(4):332-4.
Decompression sickness and recreational scuba divers.
Nakayama H, Shibayama M, Yamami N, Togawa S, Takahashi M, Mano Y.
Ushiku Aiwa General Hospital, Japan.
OBJECTIVES: The aim of this study is to clear the status of recreational scuba divers in Japan for promoting safety in recreational diving.
METHODS: A five year (from 1996 to 2001) questionnaire survey was performed of Japanese divers at the Osezaki area in Japan. The subjects of this survey included diving instructors as well as recreational divers. Based on the obtained data, the study investigated the theory predicted incidence of decompression sickness (DCS) among Japanese recreational divers. RESULTS: The average (SD) of the maximum depth for diving was 37.4 (13.1) metres, which was deeper than the recommended depth of recreational diving. The incident rate of nitrogen narcosis (12%) was the most

frequent, followed by barotraumas of the ear (11%) and barotraumas of the paranasal sinus (5.6%). The rate of DCS was 1.9 % (60 divers) during investigated period, and that DCS occurred once per 19 011 dives in calculation. CONCLUSIONS: This investigation showed that the status of leisure diving in Japan is still serious, because DCS would be expected to occur once a weekend in Japan. It is speculated that many divers may develop DCS while moving through high altitudes after diving, particularly at the Osezaki diving spot in Japan. Based on the results of this study, it is emphasised that every Japanese leisure diver should take an increasing interest in the safety of diving activity.
PMID: 12835342 [PubMed - indexed for MEDLINE]

85: Sangyo Eiseigaku Zasshi. 2003 May;45(3):97-104.
[Central nervous system involvement in patients with decompression illness]
[Article in Japanese]
Kohshi K, Katoh T, Abe H, Wong RM.
Department of Neurosurgery, Division of Hyperbaric Medicine, University of Occupational and Environmental Health, 1-1 Iseigaoka, Yahatanishiku, Kitakyushu 807-8555, Japan.
Dysbarism or decompression illness (DCI), a general term applied to all pathological changes secondary to altered environmental pressure, has two forms decompression sickness (DCS) and arterial gas embolism (AGE) after pulmonary barotrauma. Cerebral and spinal disorders have been symptomatically categorized as AGE and DCS, respectively. Magnetic resonance images (MRIs) of divers with DCI showed multiple cerebral infarction in the terminal and border zones of the brain arteries. In addition, there were no differences between MRI findings for compressed air and breath-hold divers. Although the pathogenesis of the brain is not well understood, we propose that arterialized bubbles passing through the lungs and heart involved the brain. From the mechanisms of bubble formation, however, this disorder has been classified as DCS. We propose that there is a difference between clinical and mechanical diagnoses in the criteria of brain DCI. In

contrast to brain injury, the spinal cord is involved only in compressed air divers, and is caused by disturbed venous circulation due to bubbles in the epidural space. The best approach to prevent diving accidents is to make known the problems for professional and amateur divers.

Publication Types: Review
Review, Tutorial
PMID: 12833851 [PubMed - indexed for MEDLINE]

86: Curr Sports Med Rep. 2003 Feb;2(1):15-7.
Exercise-related headache.
Turner J.

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jltturner@clarian.org

Headache related to exercise is present in many active individuals. Prospective studies on exercise-related headache are rare. There are several subtypes of headache either exacerbated or caused exclusively by exercise or exertion. Many descriptors exist, but few clear guidelines have been established to allow the practitioner to easily differentiate and treat these subtypes. Recent research has gained insight into new types of exertional headache, as well as broadened our understanding of known types. Other reviews have recommended careful thorough screening of patients with sudden onset of headache during or shortly after exercise. This article offers a concise overview of current thinking and recent investigation, as well as areas that need continued exploration.

Publication Types: Review
Review, Tutorial
PMID: 12831671 [PubMed - indexed for MEDLINE]

87: Comp Biochem Physiol A Mol Integr Physiol. 2003 Jul;135(3):477-87.

Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice.

Ponganis PJ, Van Dam RP, Levenson DH, Knower T, Ponganis KV, Marshall G.

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California San Diego, La Jolla, CA 92093-0204, USA. pponanis@ucsd.edu
Temperatures were recorded at several body sites in emperor penguins (*Aptenodytes forsteri*) diving at an isolated dive hole in order to document temperature profiles during diving and to evaluate the role of hypothermia in this well-studied model of penguin diving physiology. Grand mean temperatures (\pm S.E.) in central body sites during dives were: stomach: 37.1 ± 0.2 degrees C (n=101 dives in five birds), pectoral muscle: 37.8 ± 0.1 degrees C (n=71 dives in three birds) and axillary/brachial veins: 37.9 ± 0.1 degrees C (n=97 dives in three birds). Mean diving temperature and duration correlated negatively at only one site in one bird (femoral vein, $r = -0.59$, $P < 0.05$; range < 1 degrees C). In contrast, grand mean temperatures in the wing vein, foot vein and lumbar subcutaneous tissue during dives were 7.6 ± 0.7 degrees C (n=157 dives in three birds), 20.2 ± 1.2 degrees C (n=69 in three birds) and 35.2 ± 0.2 degrees C (n=261 in six birds), respectively. Mean limb temperature during dives negatively correlated with diving duration in all six birds ($r = -0.29$ to -0.60 , $P < 0.05$). In two of six birds, mean diving subcutaneous temperature negatively correlated with diving duration ($r = -0.49$ and -0.78 , $P < 0.05$). Sub-feather temperatures decreased from 31 to 35 degrees C during rest periods to a grand mean of 15.0 ± 0.7 degrees C during 68 dives of three birds; mean diving temperature and duration correlated negatively in one bird ($r = -0.42$, $P < 0.05$). In general, pectoral, deep venous and even stomach temperatures during diving reflected previously measured vena caval temperatures of 37-39 degrees C more closely than the anterior abdominal temperatures (19-30 degrees C) recently recorded in diving emperors. Although prey ingestion can result in cooling in the stomach, these findings and the lack of negative correlations between internal temperatures and diving duration do not support a role for hypothermia-induced metabolic suppression of the abdominal organs as a mechanism of extension of aerobic dive time in

emperor penguins diving at the isolated dive hole. Such high temperatures within the body and the observed decreases in limb, anterior abdomen, subcutaneous and sub-feather temperatures are consistent with preservation of core temperature and cooling of an outer body shell secondary to peripheral vasoconstriction, decreased insulation of the feather layer, and conductive/convective heat loss to the water environment during the diving of these emperor penguins. PMID: 12829055 [PubMed - indexed for MEDLINE]

88: Wilderness Environ Med. 2003 Summer;14(2):83-8.

Experienced scuba divers in Australia and the United States suffer considerable injury and morbidity.

Taylor DM, O'Toole KS, Ryan CM. Emergency Department, Royal Melbourne Hospital, Parkville, Victoria, Australia. david.taylor@mh.org.au

OBJECTIVE: Scuba diving-specific injuries have been well described. However, the injury experiences of individual divers over long diving careers have rarely been investigated. Our objective was to study the acute and chronic injuries of experienced, recreational scuba divers. METHODS: This was an international, cross-sectional, descriptive postal survey of experienced, recreational scuba divers belonging to diving clubs in Australia and the United States. RESULTS: Seven hundred nine divers were enrolled (346 Australian divers and 363 US divers). Most participants were experienced (mean number of dives, 262) male divers (488; 68.8%) aged 31 to 50 years (425; 59.9%). Mild barotrauma was common. Ear, sinus, and tooth "squeeze" had been experienced on > or = 1 occasion by 369 (52.1%), 245 (34.6%), and 66 (9.2%) divers, respectively. Tympanic membrane (TM) rupture, round/oval window rupture, and subcutaneous emphysema had been experienced by 38 (5.4%), 8 (1.1%), and 5 (0.7%) divers, respectively. No diver reported pneumothorax or arterial gas embolism (AGE); however, 31 divers (4.4%) had suffered decompression sickness (DCS). A wide range of other

injuries were reported. Sixteen divers (2.3%) reported permanent disabilities, which largely consisted of hearing loss, tinnitus, and balance disorder. CONCLUSIONS: The majority of experienced divers who responded to the survey had suffered diving-related injuries, mainly barotrauma. Further research and diver education are needed to better document injury rates and minimize serious diving-related injuries and permanent disabilities. PMID: 12825881 [PubMed - indexed for MEDLINE]

89: J Appl Physiol. 2003 Oct;95(4):1460-6. Epub 2003 Jun 20. Spleen volume and blood flow response to repeated breath-hold apneas.

Bakovic D, Valic Z, Eterovic D, Vukovic I, Obad A, Marinovic-Terzic I, Dujic Z.

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The purpose of this study was 1) to answer whether the reduction in spleen size in breath-hold apnea is an active contraction or a passive collapse secondary to reduced splenic arterial blood flow and 2) to monitor the spleen response to repeated breath-hold apneas. Ten trained apnea divers and 10 intact and 7 splenectomized untrained persons repeated five maximal apneas (A1-A5) with face immersion in cold water, with 2 min interposed between successive attempts. Ultrasonic monitoring of the spleen and noninvasive cardiopulmonary measurements were performed before, between apneas, and at times 0, 10, 20, 40, and 60 min after the last apnea. Blood flows in splenic artery and splenic vein were not significantly affected by breath-hold apnea. The duration of apneas peaked after A3 (143, 127, and 74 s in apnea divers, intact, and splenectomized persons, respectively). A rapid decrease in spleen volume (approximately 20% in both apnea divers and intact persons) was mainly completed throughout the first apnea. The spleen did not recover in size between apneas and only partly recovered 60 min after A5. The well-known physiological responses to

apnea diving, i.e., bradycardia and increased blood pressure, were observed in A1 and remained unchanged throughout the following apneas. These results show rapid, probably active contraction of the spleen in response to breath-hold apnea in humans. Rapid spleen contraction and its slow recovery may contribute to prolongation of successive, briefly repeated apnea attempts.

PMID: 12819225 [PubMed - indexed for MEDLINE]

90: Clin Leadersh Manag Rev. 2003 May-Jun;17(3):162-4.

Hidden nuggets: nautical archeology and laboratory management.

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Although the professions of nautical archaeology and clinical laboratory management seem to involve different bodies of knowledge, many of the principles and truisms of archaeology correlate to the art of laboratory management. On two occasions, I have been a member of a team excavating a 350-year-old shipwreck off the north shore of the Dominican Republic. I have illustrated those experiences to demonstrate that these seemingly disparate professions share frustrations that interfere with the pursuit of useful knowledge as well as successes that lead to new knowledge.

PMID: 12813957 [PubMed - indexed for MEDLINE]

91: Croat Med J. 2003 Jun;44(3):355-9.

Scuba diver with a knife in his chest: homicide or suicide?

Petri NM, Definis-Gojanovic M, Andric D.

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A scuba diver was found dead at the bottom of an undersea cave at 54.1 m water depth, with a knife protruding from his chest. Autopsy confirmed death due to both drowning and a penetrating knife wound. The incident was first considered a homicide and two suspects were arrested. Careful forensic analysis

of the profile of the diver's last dive stored in the dive computer, dimensions of the undersea cave, as well as other forensic findings, showed that the case was a suicide, which the diver most probably committed while running out of air, in an attempt to avoid the agony of drowning. To the best of our knowledge, this is the first report on a suicide during diving.

Publication Types: Case Reports
PMID: 12808733 [PubMed - indexed for MEDLINE]

92: Rev Neurol. 2003 Jun 1-15;36(11):1040-4.

Comment in: Rev Neurol. 2003 Sep 16-30;37(6):600; author reply 600.

[Acute myelopathy in a diver caused by decompression sickness. A case description and a survey of the literature]

[Article in Spanish]

Carod-Artal FJ, Vilela-Nunes S, Fernandes-da Silva TV.

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INTRODUCTION: Decompression sickness (DS) is caused when bubbles of an inert gas usually nitrogen, since oxygen is metabolised in the tissues are released into the bloodstream and tissues during fast ascents once the atmospheric pressure is lowered near the surface. Neurological complications are its most serious form of expression and include vertigo, headache, stroke and acute myelopathy, among others. DS that affects the spinal cord is infrequent. CASE REPORT: A male, 42 years old, who presented progressive tetraparesis 15 minutes after returning to the surface following several immersions up to 40 metres deep in the same day. Neurological exploration revealed tetraparesis that was predominantly distal and in the lower limbs, a posterior cord syndrome, urinary incontinence and neurogenic pain. Total column magnetic resonance imaging showed areas of diffused hypersignal in the T2 sequence in the thoracic and cervical (C2 to C6) regions, predominating in the posterior cords. The echocardiogram, transcranial Doppler and spirometric studies ruled out an arterial gas embolism following pulmonary barotrauma. CONCLUSIONS: Spinal DS

can give rise to a serious myelopathy, which affects the pyramidal pathway, posterior cords and sphincter control, and which generally appears after sudden ascents from the deep dives.

Publication Types: Case Reports
PMID: 12808500 [PubMed - indexed for MEDLINE]

93: Nurse Pract. 2003 Jun;28(6):28-34.

Summer is prime time for diving injuries.

Hess PD.

Moncreif Army Community Hospital, Fort Jackson, SC, USA.

Publication Types: Review
Review, Tutorial

PMID: 12796621 [PubMed - indexed for MEDLINE]

94: Chest. 2003 Jun;123(6):2112-4.

Telephone diagnosis of a strange voice.

Yanir Y, Abramovich A, Beck-Razi N, Shupak A.

Israel Naval Medical Institute, Israel Defense Forces Medical Corps, Haifa, Israel.

Publication Types: Case Reports
PMID: 12796196 [PubMed - indexed for MEDLINE]

95: Emerg Med Clin North Am. 2003 May;21(2):475-97, x.

Environmental insults: smoke inhalation, submersion, diving, and high altitude.

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In the expanding search for recreation, we spend more and more of our time in various environments. Whether the air is thin or compressed or smoke-filled or there is no air at all, emergency physicians continue to meet and treat the various pulmonary emergencies that the environment may create. The authors present the background, diagnosis, and management of a few of the more common pulmonary emergencies that the environment may produce.

Publication Types: Review
Review, Tutorial

PMID: 12793625 [PubMed - indexed for MEDLINE]

96: Ear Nose Throat J. 2003 May;82(5):356-8.

A case of dizziness, headache, aural fullness, and concentration difficulty following scuba diving.

Brookler KH.

Neurotologic Associates, P.C., New York City, USA.

Publication Types: Case Reports
PMID: 12789759 [PubMed - indexed for MEDLINE]

97: Ann Otol Rhinol Laryngol. 2003 May;112(5):425-7.

Scuba diving with cochlear implants. Kompis M, Vibert D, Senn P, Vischer MW, Hausler R.

Department of Otorhinolaryngology-Head, Neck and Craniomaxillofacial Surgery, Inselspital, University of Berne, Berne, Switzerland.

We report on a patient with bilateral cochlear implants (a Med-El Combi40 and a Med-El Combi40+), as well as considerable experience in scuba diving with both of his implants. After having been exposed to 68 and 89 dives, respectively, in depths of up to 43 m, both cochlear implants are in working order and the patient continues to receive excellent speech recognition scores with both cochlear implant systems. The presented data show that scuba diving after cochlear implantation is possible over a considerable number of dives without any major negative impact on the implants.

Publication Types: Case Reports
PMID: 12784981 [PubMed - indexed for MEDLINE]

98: J Theor Biol. 2003 Jul 7;223(1):79-92.

Optimal diving under the risk of predation.

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Many air-breathing aquatic foragers may be killed by aerial or subsurface predators while recovering oxygen at the surface; yet the influence of predation risk on time allocation during dive cycles is little known in spite of numerous studies on optimal diving. We modeled diving behavior under the risk of predation at the surface.

The relationship between time spent at the surface and the risk of death is predicted to influence the optimal surface interval, regardless of whether foragers accumulate energy at a constant rate while at the food patch, deplete food resources over the course of the dive, or must search for food during the dive. When instantaneous predation risk during a single surface interval decreases with time spent at the surface, a diver should increase its surface interval relative to that which maximizes energy intake, thereby increasing dive durations and reducing the number of surfacings per foraging bout. When instantaneous risk over a single surface interval does not change or increases with increasing time at the surface, divers should decrease their surface interval (and consequently their dive duration) relative to that which maximizes energy intake resulting in more dives per foraging bout. The fitness consequences of selecting a suboptimal surface interval vary with the risk function and the way divers harvest energy when at depth. Finally, predation risk during surface intervals should have important consequences for habitat selection and other aspects of the behavioral ecology of air-breathing aquatic organisms.

PMID: 12782118 [PubMed - indexed for MEDLINE]

99: Occup Environ Med. 2003 Jun;60(6):418-22.

Evaluation of decompression safety in an occupational diving group using self reported diving exposure and health status.

Doolette DJ, Gorman DF.

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BACKGROUND: Many occupational diving groups have substantially different diving patterns to those for which decompression schedules are validated. AIMS: To evaluate tuna farm occupational diving practice against existing decompression models and describe a method for collecting and modelling self reported field decompression data. METHODS: Machine readable objective depth/time profiles were obtained from depth/time recorders worn by

tuna farm occupational divers. Divers' health status was measured at the end of each working day using a self administered health survey that produces an interval diver health score (DHS) with possible values ranging from 0 to 30. Depth/time profiles were analysed according to existing decompression models. The contribution of diving exposure and between diver variability to DHS was evaluated using linear regression. RESULTS: The mean risk of decompression sickness was calculated as 0.005 (SD 0.003, n = 383). The mean DHS following diving was 3 (SD 2, n = 383) and following non-diving activities was 1 (SD 1, n = 41). After accounting for between diver variability in intercept, DHS was found to increase one unit for every 1% increase in the risk of decompression sickness. CONCLUSIONS: A method has been established for the collection and analysis of self reported objective decompression data from occupational diving groups that can potentially be used as the basis for development of purpose designed occupational diving decompression schedules.

Publication Types: Evaluation Studies

PMID: 12771393 [PubMed - indexed for MEDLINE]

100: Clin Physiol Funct Imaging. 2003 May;23(3):149-54.

Hyperbaric hyperoxia induces a neuromuscular hyperexcitability: assessment of a reduced response in elite oxygen divers.

Jammes Y, Arbogast S, Faucher M, Montmayeur A, Tagliarini F, Meliet JL, Robinet C.

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We compared the changes in compound muscle mass action potential (M-wave) recorded in vastus lateralis in response to hyperbaric hyperoxia (HBO) in nine combat divers who dived daily while breathing 100% O₂ or O₂-enriched mixture (O₂ divers) to those measured in eight recreational divers who dived occasionally using compressed

air/21% O₂ (air divers). The O₂ divers completed a 6-h HBO exposure in which the inspired oxygen pressure (PiO₂) varied from 1.15 to 2.7 absolute atmospheres (ATA), PiO₂ being maintained at 1.15 ATA throughout the first 2-h period, whereas the air divers only completed a 2-h HBO exposure with PiO₂ constant at 1.15 ATA. Before HBO exposure, there were no intergroup differences between baseline M-wave characteristics (amplitude and duration), but the conduction time was significantly shorter in O₂ divers compared with air divers. After 90 min of HBO (1.15 ATA) the air divers demonstrated neuromuscular hyperexcitability, as evidenced by an increased M-wave amplitude (13%, P<0.01 versus baseline), shortened M-wave duration (5%, P<0.05 versus baseline), and reduced conduction time (5%, P<0.01 versus baseline). In O₂ divers, similar HBO-induced M-wave changes were only observed when PiO₂ was greater than 1.50 ATA. We conclude that HBO elicits neuromuscular hyperexcitability, attenuated in elite O₂ divers.

Publication Types: Clinical Trial
Controlled Clinical Trial
PMID: 12752557 [PubMed - indexed for MEDLINE]

101: Aviat Space Environ Med. 2003 May;74(5):537-45.

Training improves divers' ability to detect increased CO₂.

Eynan M, Daskalovic YI, Arieli Y, Arieli R, Shupak A, Eilender E, Kerem DH.

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BACKGROUND: Elevated arterial PCO₂ (hypercapnia) is a known risk in diving with closed circuit breathing apparatus. In a retrospective study, we determined CO₂ retention and the ability to detect CO₂ in novice divers who were either CO₂-recognition-trained subjects (TS) or untrained subjects (UTS). METHODS: Ventilatory and perceptual responses to variations in inspired CO₂ (range 0-5.6 kPa, 0-42 mm Hg) during moderate exercise were assessed in novice Israeli Navy divers on active duty. Tests were carried out on 231 TS and 213 UTS. RESULTS: The minimal mean inspired PCO₂ that could be detected was 4.8 +/- 1.6 kPa (36 +/-

12 mm Hg) in UTS and 2.9 +/- 0.7 kPa (22 +/- 5 mm Hg) in TS (p < 0.0001). No significant changes were found in PETCO₂ between the two groups during exposure to a PICO₂ of 5.6 kPa (42 mm Hg). There were 46 TS who were found to be CO₂ retainers (more than +1 SD above the mean) and 19 were classified as poor detectors (more than +1 SD above the mean). Seven subjects exhibited both traits. During actual oxygen diving performed later by this group, the only four cases of CNS-oxygen toxicity were among those seven subjects (p < 0.01). CONCLUSIONS: We conclude that CO₂ recognition training improves the diver's capability to detect CO₂. We suggest that a diver who is both a poor CO₂ detector and a CO₂ retainer will be prone to CNS-oxygen toxicity.

PMID: 12751583 [PubMed - indexed for MEDLINE]

102: J R Army Med Corps. 2003 Mar;149(1):15-22.

Common medical disorders related to diving--prevention, diagnosis and fundamentals of treatment. Part 1: Diving disorders that do not require recompression.

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Publication Types: Review
Review, Tutorial

PMID: 12743921 [PubMed - indexed for MEDLINE]

103: Int J Sports Med. 2003 Apr;24(3):162-5.

Ventilatory and metabolic response to rebreathing the expired air in the snorkel.

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The snorkel, which allows swimmers to keep their face down in the water while breathing, is widely used by divers, spear fishermen and monofin swimmers. A snorkel adds an additional dead space of 160-170 ml and causes an increase in the concentration of CO₂ in the inspired gas due to expired air trapped in the snorkel which is then re-

inspired. In this study the metabolic and the ventilatory response to rebreathing the expired air in the snorkel were investigated in twelve human subjects. A 2900 C Sensor Medics gas analyzer was used in breath-by-breath mode for the measurements. Ventilation (VE), respiratory rate (RR), tidal volume (TV), oxygen consumption (.VO₂) and carbon dioxide production (.VCO₂) were measured at rest and during light exercise both with and without the snorkel dead space. We observed a significant increase in all variables except RR, when subjects rebreathed the gas in the snorkel. The increase in ventilation resulted from an increase in tidal volume rather than increasing respiratory rate. We conclude that the work of breathing is increased when CO₂ concentration is high in inspired gas and re-breathing while snorkelling can be prevented by a new snorkel design with a low-resistance two-way non-rebreathing valve, which will allow the expired air flow into the water.

Publication Types: Clinical Trial
PMID: 12740732 [PubMed - indexed for MEDLINE]

104: Neth J Med. 2003 Feb;61(2):50-3.

Comment in: Neth J Med. 2003 Nov;61(11):388-9; author reply 389.
Bleomycin and scuba diving: to dive or not to dive?

Huls G, ten Bokkel Huinink D.
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Bleomycin is to treat patients with testicular cancer and lymphoma. Bleomycin can bind to DNA and chelate iron. The resulting complex can form an intermediate capable of interacting with oxygen to produce reactive oxygen species, particularly superoxide. Adminstrating high-inspired oxygen concentrations (e.g. during anaesthesia or acute illness) has been reported to exacerbate pulmonary injury. The duration of risk after bleomycin chemotherapy is unknown. Here we discuss our advice to a young male patient, who was successfully treated with bleomycin for testicular cancer, concerning the safety to return to scuba

diving. Since scuba divers are exposed to high partial oxygen pressures (depending on the depth of the dive) we discouraged this patient from resuming scuba diving.

Publication Types: Case Reports
PMID: 12735422 [PubMed - indexed for MEDLINE]

105: Appl Neuropsychol. 2003;10(1):23-30.

The neuropsychology of repeated 1- and 3-meter springboard diving among college athletes.

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This study examined the neuropsychological effects of repeated springboard diving. It was hypothesized that the impact velocity, which can range from 20 to 30 mph, and accompanying deceleration in the water may lead to concussions and affect the diver's cognitive function. Six varsity National Collegiate Athletic Association Division 1 springboard divers participated in the study. Each diver performed a total of 50 practice dives from either the 1- or 3-m springboard. After each set of 10 dives, the participants were immediately evaluated at poolside using the Symbol Digit Modalities Test, the Stroop Color Word Test, and the Trail Making Test B. Baseline testing revealed, consistent with their athletic specialty, clear neurocognitive strengths among the divers on tests sensitive to proprioception, motor speed, and visual-spatial organization. Results from the serial assessments indicated no detectable neuropsychological deficits among competitive divers compared to baseline testing. Skilled diving at the collegiate level appears to be a safe sport and water appears to present the perfect medium for gradual deceleration. More studies, however, are warranted for 5-, 7.5-, and 10-m platform diving since the impact velocity of the diver from these heights is higher.

PMID: 12734072 [PubMed - indexed for MEDLINE]

106: Ambio. 2003 Mar;32(2):140-4.

Recreational scuba diving in Caribbean marine protected areas: do the users pay?

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There are more than 200 marine protected areas (MPAs) in the Caribbean and Central America that contain coral reefs and are therefore theoretically attractive to scuba divers. One fifth of dive operators in 30 countries were surveyed for their use of MPAs: the majority are located within 20 km of at least one MPA and 46% conduct at least 80% of their diving within a MPA. An estimated 15 million dives take place outside of Florida each year, half of these occurring inside MPAs. Only 25% of MPAs containing coral reefs charge divers an entry or user fee, which is most usually USD 2-3 levied per dive or per diver. The revenue generated by these fees is estimated at USD 1-2 million annually, but the potential for generating income has not been fully realized. A significant contribution to the cost of regional conservation could be achieved if higher fees were applied more widely than at present.

PMID: 12733800 [PubMed - indexed for MEDLINE]

107: J Exp Biol. 2003 Jun;206(Pt 11):1929-40.

Unconventional ventral attachment of time-depth recorders as a new method for investigating time budget and diving behaviour of seabirds.

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We tested the use of commercially available electronic time-depth recorders (TDRs) to quantify activities and thus total time budgets of seabirds. This new method involved first fitting TDRs onto the birds' bellies (not on their backs), and, secondly, analysing continuous recordings of temperature, light and pressure to differentiate activities on land and at sea. The birds

studied were 12 common guillemots (*Uria aalge*) rearing chicks at Hornoya, in northern Norway. The method successfully recorded five different activities: at the colony, flying, diving, and resting or active at the sea surface. Overall, common guillemots spent 68% of their time at the colony and 32% at sea. While at sea, the birds spent the majority (77%) of their time at the surface, during which they were active 64% of the time, and rested only 13%. Birds engaged in the costly behaviours of flying and diving for shorter times (11% and 12% of their time at sea, respectively). The method allowed us to differentiate between two types of trips to sea based on the presence (foraging trips: 77% of the total number of trips) or absence (non-foraging trips: 23%) of dives. On average, foraging trips lasted 3.2 h, but most trips were shorter (<1 h), during which the mean estimated travel distance from the colony was 11 km. Diving occurred in bouts of 7.7+/-6.6 dives (mean +/- S.D.). The mean maximum dive depth was 10.2+/-7.6 m (deepest dive: 37 m), and the mean dive duration and post-dive intervals were 38.7+/-21.3 s (longest dive: 119 s) and 20+/-12 s, respectively. Direct and indirect evidence suggests that common guillemots had no difficulty in finding food during the study period, and that the TDRs had minimal effects on the birds' behaviour and physiology. The method is easy to use in the field and is applicable to many other flying seabird species; it is therefore an efficient way of collecting information on time budgets and diving behaviour in the context of various ecological and monitoring studies.

PMID: 12728014 [PubMed - indexed for MEDLINE]

108: Lancet Infect Dis. 2003 May;3(5):316.

Seizing the opportunity.

Dixon B.

Publication Types: Case Reports
PMID: 12726987 [PubMed - indexed for MEDLINE]

109: Rev Mal Respir. 2003 Feb;20(1 Pt 1):147-8.

[Diving and asthma: follow-up]

[Article in French]
Le Comite de Redaction.
Publication Types: Letter
PMID: 12709645 [PubMed - indexed for MEDLINE]

110: Rev Mal Respir. 2003 Feb;20(1 Pt 1):144-6.
[Lung bullae: never to dive again]
[Article in French]
Jego C, Berard H, Barbou F, Moulin P, Meliet JL.
Service de Pneumologie, Hopital d'Instruction des Armees Sainte-Anne, Toulon-Naval, France.
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Publication Types: Case Reports
PMID: 12709644 [PubMed - indexed for MEDLINE]

111: Surg Today. 2003;33(4):299-301.
Gastric barotrauma in a scuba diver: report of a case.
Titu LV, Laden G, Purdy GM, Wedgwood KR.
Academic Surgical Unit, Castle Hill Hospital, Castle Road, Cottingham, North Humberside HU16 5JQ, UK.
Stomach rupture can occur as a consequence of the expansion of compressed air during rapid ascent after diving. We present the case of a middle-aged woman who suffered a gastric tear from surfacing too quickly after diving, and discuss the diagnosis and management of such patients by reviewing previously reported similar events. Gastric barotrauma should be suspected in divers who complain of abdominal pain, even in the absence of frank signs of peritoneal irritation. Although pneumoperitoneum is always present in these patients, it can also occur as a consequence of pulmonary barotrauma, making gastroscopy or radiological contrast studies, or both, essential for a definitive diagnosis. Surgical repair represents the treatment of choice for an active full-thickness tear and, if associated with arterial gas embolism or decompression sickness, should ideally be performed in a center where a category I (intensive care-capable) hyperbaric unit is available.
Publication Types: Case Reports
PMID: 12707828 [PubMed - indexed for MEDLINE]

112: Emerg Med Serv. 2003 Apr;32(4):67-8.
The spice of life. Exploring your EMS career options.
McCormick D.
Nassau County Police Department, Long Island, NY, USA.
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PMID: 12705220 [PubMed - indexed for MEDLINE]

113: J Exp Biol. 2003 May;206(Pt 10):1751-63.
Patterns of respiration in diving penguins: is the last gasp an inspired tactic?
Wilson RP, Simeone A, Luna-Jorquera G, Steinfurth A, Jackson S, Fahlman A.
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Humboldt penguins *Spheniscus humboldti* in captivity and free-living Magellanic penguins *S. magellanicus* were fitted with loggers to determine beak angles during breathing. The Humboldt penguins were also fitted with masks for determining rates of air flow during breathing. During periods of higher gas exchange requirement, Humboldt penguins opened their beaks during inspiration, where tidal volume was linearly correlated with both change in beak angle and maximum beak angle, closed them slightly during the final stages of inspiration and finally closed them during expiration. Substantial differences were apparent between individuals. Contrary to the condition proposed for most birds, our data suggest that expiration is passive during periods of high respiratory tidal volumes, and that the increased resistance of the respiratory pathway serves to slow air flow so as to maximize gas exchange in the lungs. During foraging, Magellanic penguins at the surface between dives showed similar breathing patterns but maximum beak angles were much higher and breath cycle time shorter, as would be expected for animals attempting to maximize gas exchange. Both maximum beak angle per breath and breath frequency changed systematically over the surface pause; both were initially high, then decreased to a low before rising again to a maximum just before diving. Based on known

changes in tidal volume with beak angle derived from Humboldt penguins, a simple model is proposed to examine rates of gas exchange over the surface pause. This indicates that the observed patterns do not maximize the rate of transfer of oxygen over the whole of the surface pause but are rather concerned with an initial rapid accumulation of oxygen in the tissues followed by effective carbon dioxide release.
PMID: 12682106 [PubMed - indexed for MEDLINE]

114: J Korean Med Sci. 2003 Apr;18(2):281-3.
Massive pneumoperitoneum after scuba diving.
Oh ST, Kim W, Jeon HM, Kim JS, Kim KW, Yoo SJ, Kim EK.
Department of Surgery, College of Medicine, The Catholic University of Korea, Seoul, Korea.
Pneumoperitoneum usually indicates rupture of a hollow viscus and considered a surgical emergency. But air may also enter the peritoneum from the lung or the genital organs in female without visceral perforation. While scuba diving, the rapid ascent is usually controlled by placing in a decompression chamber and the excess gas volume is exhaled. Failure to allow this excess gas to escape will result in overdistension of air passage, which may rupture resulting in pulmonary interstitial emphysema or, if air enters the circulation, air embolus can occur. Pneumo-peritoneum is a rare complication of diving accidents. While the majority of cases are not related to an intraabdominal catastrophe, more than 20% have been the result of gastric rupture. We report a 42-yr-old male patient with massive pneumoperitoneum after scuba diving, who presented himself with dyspnea and abdominal distension. Knowledge of this rare condition and its benign course may allow the emergency physician and surgeon to order appropriate studies to help avoid unnecessary surgical treatment. It is important to determine promptly whether the air emanated from a ruptured viscus or was introduced from an extraperitoneal source. Free air in

the abdomen does not always indicate a ruptured intra-abdominal viscus.
Publication Types: Case Reports
PMID: 12692430 [PubMed - indexed for MEDLINE]

115: Aviat Space Environ Med. 2003 Apr;74(4):320-5.
Balance testing and Doppler monitoring during hyperbaric exposure.
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BACKGROUND: The effects on the postural system of saturation diving to shallow and medium depths have not previously been adequately tested. The purpose of this study was to investigate whether postural function is affected by a moderate hyperbaric exposure, and whether any deterioration is correlated with the presence of intravascular bubbles. HYPOTHESIS: Postural control and the vestibulo-ocular reflex are not affected during heliox saturation diving to 5 meters of seawater (msw). At greater depths, an effect may occur. METHODS: Postural control was tested with the subjects standing on a static balance platform before, during, and after onshore experimental saturation chamber dives to 5 msw heliox, 20 msw air, and to 100 msw heliox. Standard caloric testing with electronystagmography was performed before and after the heliox dives. Cardiac ultrasound and Doppler monitoring were used to detect possible venous gas emboli (VGE) during decompression in the heliox dives. RESULTS: During the heliox exposure to 5 msw, no significant change in body sway was found. However, a significant change in body sway was found during an air dive to 20 msw and during the 100 msw heliox exposure. Caloric responses were unchanged immediately post-dive. After decompression from 5 msw, VGE were detected in two divers. During the 100 msw exposure, one case of VGE was observed. CONCLUSIONS: Exposure to hyperbaric heliox conditions corresponding to 5 msw, did not influence postural control significantly, while exposure to 100 msw heliox, and air

diving to 20 msw, did. Although VGE were detected in the heliox dives, we could not find any correlation between this observation and postural instability.
PMID: 12688449 [PubMed - indexed for MEDLINE]

116: Int J Sports Med. 2003 Feb;24(2):104-7.

Arterial blood gases during diving in elite apnea divers.

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Elite apnea divers have considerably extended the limits of dive depth and duration but the mechanisms allowing humans to tolerate the compression- and decompression-induced changes in alveolar gas partial pressures are still not fully understood. Therefore we measured arterial blood gas tensions and acid-base-status in two elite apnea divers during simulated wet dives lasting 3 : 55 and 5 : 05 minutes, respectively. Arterial pO₂ followed the compression-(from 13.8/16.9 kPa before the dive to 30 kPa at the start of the bottom time) and decompression-induced (from 13.7/21.0 kPa to 3.3/4.9 kPa immediately after surfacing) variations of ambient pressure, while the arterial pCO₂ remained within the physiologic range (3.0/3.9 kPa before diving vs. 5.7/5.9 kPa at the end of the bottom time), probably due to the CO₂ storage capacity of the blood. These findings may help to explain why humans can sustain deep and long apnea dives without major increases in respiratory drive.

PMID: 12669255 [PubMed - indexed for MEDLINE]

117: J Exp Biol. 2003 May;206(Pt 9):1461-70.

Factors affecting stroking patterns and body angle in diving Weddell seals under natural conditions.

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Aquatic animals use a variety of strategies to reduce the energetic cost of locomotion. Efficient locomotion is particularly important for breath-holding divers because high levels of exercise may quickly deplete oxygen reserves, leading to the termination of a dive. We investigated the swimming behavior of eight adult Weddell seals, which are proficient divers, in McMurdo Sound, Antarctica. A newly developed data logger was attached to free-ranging females at their own breeding sites to record swimming speed, depth, two-dimensional accelerations (stroke frequency and body angle) and temperature. All seals conducted multiple deep dives (the mean dive depth range for each animal was 223.3+/-66.5-297.9+/-164.7 m). Prolonged gliding while descending was observed with thinner females (N=5 seals). But the fatter females (N=3 seals) exhibited only swim-and-glide swimming, characterized by intermittent stroking and fluctuating swim speed, throughout their descent and ascent. The body angles of four of the seals were restricted to less than 30 degrees by the location of breathing holes in the ice and the slope of local bathymetric features. Of these four, the three fatter seals adopted the stroke-and-glide method while the other thinner seal descended with prolonged periods of gliding. Prolonged gliding seems to be a more efficient method for locomotion because the surface time between dives of gliding seals was significantly less than that of stroking animals, despite their same stroke frequencies.

PMID: 12654885 [PubMed - indexed for MEDLINE]

118: Aviat Space Environ Med. 2003 Mar;74(3):236-41.

Self-reported headache during saturation diving.

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INTRODUCTION: Some commercial divers have claimed that headache is a frequent symptom related to decompression following a saturation dive, but due to lack of systematic

reporting there is limited knowledge of the incidence and clinical characteristics of such headaches. METHODS: During 2001, a questionnaire was distributed to divers participating in offshore saturation diving operations on the Norwegian continental shelf. Two major diving contractors participated. The survey allowed anonymous self-reporting of past and present problems with headache; pain intensity was indicated daily on a visual analog scale (VAS) from 0 to 10. Of 95 divers, 56 participated and 67 saturations were registered. RESULTS: The divers estimated a higher frequency of headaches in connection to saturation diving than in everyday life ($p < 0.001$). One third of the divers reported experiencing headache after they finished decompression. There was a significant increase in reports of headache on the last day of decompression ($p = 0.03$) and on the first day post-saturation ($p < 0.001$) compared with the start of decompression. Median headache duration was 6 h (range 1-84 h) and median pain score estimated on a VAS was 2.5 (range 0.1-7.8), equivalent to moderate intensity. CONCLUSIONS: Headache incidence is greater in divers during saturation diving than in everyday life. The increase is correlated to the last phase of decompression and the post-saturation period. No specific cause(s) of the headache could be identified, but we discuss possible explanations.

PMID: 12650270 [PubMed - indexed for MEDLINE]

119: Aviat Space Environ Med. 2003 Mar;74(3):228-35.

Field trials of no-decompression stop limits for diving at 3500 m. Egi SM, Gurmen NM, Aydin S.

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INTRODUCTION: In 1990, Bogazici University (Istanbul, Turkey) launched an altitude diving program to develop techniques and safe decompression profiles for diving at high terrestrial altitudes. Following pioneering diving expeditions to lakes at high elevations in 1990-1992, it was deemed necessary to calculate new

tables. METHODS: Bottom time limits for dives requiring no decompression stops (no-d) were calculated for 3500 m using linear extrapolation of U.S. Navy M-values decreased by 4 ft of sea water (M4 limits). These limits were tested for 15, 18, 21, 24, 27, and 30 m of depth by diving in the Great Sea Lake at Mt Kackar (3412 m) with 10 dives per profile. RESULTS: The mean decompression sickness (DCS) risk estimated from precordial bubble scores (Spencer Scale) ranged from 0.3% to 2.8% per profile. After three expeditions, 165 dives had been achieved with a cumulative bottom time of 3199 min. No DCS occurred in dives that adhered to the M4 no-d limits. However, two cases of Type I and one case of Type II DCS were encountered where the divers accidentally exceeded those limits. DISCUSSION: Considering the estimated risk of DCS and the relatively small number of trials, a more conservative approach was used to develop a final set of high altitude dive tables. This conclusive approach used continuous compartment half-lives. It is based on fitting a surface of allowable supersaturation limits using the empirical M-values from existing tables as well as our altitude diving data, together with an added constraint that forces calculated M-values to stay below the available M-value data.

PMID: 12650269 [PubMed - indexed for MEDLINE]

120: Int J Biometeorol. 2003 Mar;47(2):80-6. Epub 2002 Dec 11.

Effect of uniform and non-uniform skin temperature on thermal exchanges in water in humans.

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We investigated the effect of uniform (UST) and non-uniform (NUST) skin temperature on thermal exchanges during a 3-h water immersion in five male subjects wearing (NUST) or not wearing (UST) a water-perfused garment. UST was achieved by immersing the nude subject in water up to the neck. For each subject, the water temperature was adjusted to the critical

temperature ($T_{(cw)}$, 31.4 ± 0.9 degrees C) or 3 degrees C below $T_{(cw)}$ ($T_{(cw)} - 3$). NUST was achieved by perfusing different segments of the perfused garment with water of different temperatures. The water temperature of the segment was independently adjusted according to the skin temperature distribution in cold air, the mean skin temperature being the same as the UST. At $T_{(cw)}$ and $T_{(cw)} - 3$, changes in esophageal and mean skin temperatures were identical in UST and NUST conditions, but the skin temperature of the trunk was higher and that of the limb was lower in the NUST condition. Heat production and the overall skin heat flux at $T_{(cw)}$ were identical in the two conditions, but those at $T_{(cw)} - 3$ were about 25% lower ($P < 0.05$) in NUST than in UST conditions. At $T_{(cw)} - 3$, the overall tissue insulation was 36% higher ($P < 0.05$) in NUST than in UST conditions, mainly because of higher limb insulation. Thermogenesis due to shivering was lower by 62% ($P < 0.05$) in NUST than in UST. We conclude that the NUST condition increased tissue insulation and suppressed shivering. This suggests that a high skin temperature of the trunk attenuates shivering in cold water and increases the ability to defend body temperature more economically in cold water.

PMID: 12647094 [PubMed - indexed for MEDLINE]

121: Proc R Soc Lond B Biol Sci. 2003 Mar 7;270(1514):483-8.

Stroke and glide of wing-propelled divers: deep diving seabirds adjust surge frequency to buoyancy change with depth.

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In order to increase locomotor efficiency, breath-holding divers are expected to adjust their forward thrusts in relation to changes of buoyancy with depth. Wing propulsion during deep diving by Brunnich's guillemots (*Uria lomvia*) was measured in the wild by high-speed

(32 Hz) sampling of surge (tail-to-head) and heave (ventral-to-dorsal) accelerations with bird-borne data loggers. At the start of descent, the birds produced frequent surges (3.2 Hz) during both the upstroke and the downstroke against buoyancy to attain a mean speed of 1.2-1.8 m s⁻¹ that was close to the expected optimal swim speed. As they descended deeper, the birds decreased the frequency of surges to 2.4 Hz, relying only on the downstroke. During their ascent, they stopped stroking at 18 m depth, after which the swim speed increased to 2.3 m s⁻¹, possibly because of increasing buoyancy as air volumes expanded. This smooth change of surge frequency was achieved while maintaining a constant stroke duration (0.4-0.5 s), presumably allowing efficient muscle contraction.

PMID: 12641902 [PubMed - indexed for MEDLINE]

122: Ann Occup Hyg. 2003 Apr;47(3):227-33.

An in-field demonstration of the true relationship between skin infections and their sources in occupational diving systems in the North Sea.

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INTRODUCTION: Skin infections in saturation diving are caused by microbes that flourish in saturation environments. Improvements in the prevention of infections must therefore be based on environmental control and elimination. Furthermore, only a few genotypes seem to be responsible for the majority of infections in the Norwegian sector of the North Sea, and these have all been demonstrated in saturation systems for many years. Although reservoirs of infectious genotypes have been identified, their true sources have not been identified. OBJECTIVES: The purpose of this field study was to log the contamination by *Pseudomonas aeruginosa* of the saturation system throughout a diving operation. MATERIALS AND METHODS: Daily water samples from the vessels drinking water system and from the heated seawater systems to divers suits

were taken throughout the diving period of 1 month in the summer of 2001. All *P.aeruginosa* isolates were genotyped by pulsed field gel electrophoresis. RESULTS: A total of 17 *P.aeruginosa* genotypes were identified in the course of this field study. None of the most common infectious genotypes previously observed in the Norwegian sector were among these strains. Two genotypes were involved in skin infections during the period of operation: TP2 and TP12. TP2 was shown to be an inhabitant of the diving systems throughout the investigation period, while TP12 was introduced from seawater in the course of the operation and rapidly spread and established itself throughout the diving system. CONCLUSIONS: The study has demonstrated seawater as a true source of an infectious *P.aeruginosa* genotype in occupational diving systems.

PMID: 12639836 [PubMed - indexed for MEDLINE]

123: Eur J Emerg Med. 2003 Mar;10(1):35-41.

Pulmonary oedema in SCUBA divers: pathophysiology and computed risk analysis.

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SCUBA diving has become a popular sport, with an increasing number of people participating in it. Although it is an essentially very safe activity, several specific medical problems are associated with diving. The present paper addresses diving-related pulmonary oedema, which is a rarely reported condition. It has been described mostly in cold water diving, and its occurrence in warm water has not been documented before. We delineate the pathophysiology of this condition and its treatment, and use a novel computational model to analyse further the mechanisms leading to diving-related pulmonary oedema. A better understanding of diving-related pulmonary oedema may lead to earlier recognition and treatment, and, potentially, to its prevention. The physiological mechanisms likely to lead to diving-related pulmonary

oedema are well recognized. Consequently, we could design and construct a bio-mechanical computer model of the alveolar septa to explore the pathophysiology of diving-related pulmonary oedema and the vulnerability of individual divers as they relate to some mechanical characteristics of their lung structure. The physiological mechanisms of diving-related pulmonary oedema and the results provided by the computational model successfully delineated the process. The model predicted that the risk of injury is significantly increased in individuals who have a stiffer lung parenchyma or lower lung compliance values.

Publication Types: Case Reports Review

PMID: 12637860 [PubMed - indexed for MEDLINE]

124: Anesthesiol Intensivmed Notfallmed Schmerzther. 2003 Mar;38(3):206-8.

[Dangers in diving and typical diving accidents]

[Article in German]

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PMID: 12635051 [PubMed - indexed for MEDLINE]

125: Otol Neurotol. 2003 Mar;24(2):350; author reply 351.

Comment on: Otol Neurotol. 2001 Jul;22(4):430-2.

Cartilage palisade tympanoplasty, diving and eustachian tube function. Uzun C.

Publication Types: Comment Letter

PMID: 12621358 [PubMed - indexed for MEDLINE]

126: Otol Neurotol. 2003 Mar;24(2):195-200.

Persistent inner ear injury after diving.

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OBJECTIVE: The purpose of this multiple case report was to discuss the occurrence and cause of sudden sensorineural hearing loss after diving. STUDY DESIGN: The study design was a retrospective case review. SETTING: The study was

conducted at an academic tertiary referral center. PATIENTS: In this multiple case report, two teenagers with unilateral sudden sensorineural hearing loss after diving, one from a starting block and one from a 1-m board, while performing school swimsports were included. INTERVENTION: The patients underwent diagnostic tympanotomy with sealing of the round and oval window membranes and a vasoactive rheologic therapy combined with corticosteroid treatment. MAIN OUTCOME MEASURES: The average pure-tone bone-conduction thresholds were calculated. The appearance of nystagmus, vertigo, and tinnitus was analyzed. RESULTS: Both patients experienced unilateral sudden deafness after performing a headfirst pike-type dive into a swimming pool. None of the patients contacted with the bottom of the pool. In one patient, a rupture of the round window was found intraoperatively. In the other patient, no rupture of the round or oval window was seen intraoperatively. In spite of sealing of the round window and application of vasoactive rheologic therapy, hearing did not improve significantly in either of the patients. CONCLUSION: Rupture of the round window may occur after diving even if the dive is performed from a low height into the water and the bottom of the pool is not contacted. Besides direct contusion to the external ear and barotrauma, other causes such as whiplash mechanism have to be considered.

Publication Types: Case Reports
PMID: 12621331 [PubMed - indexed for MEDLINE]

127: Environ Monit Assess. 2003 Jan-Feb;81(1-3):43-50.

Conservation and management applications of the REEF volunteer fish monitoring program.

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The REEF Fish Survey Project is a volunteer fish monitoring program developed by the Reef Environmental Education Foundation (REEF). REEF volunteers collect fish distribution and abundance data using a

standardized visual method during regular diving and snorkeling activities. Survey data are recorded on preprinted data sheets that are returned to REEF and optically digitized. Data are housed in a publicly accessible database on REEF's Web site (<http://www.reef.org>). Since the project's inception in 1993, over 40,000 surveys have been conducted in the coastal waters of North America, tropical western Atlantic, Gulf of California and Hawaii. The Fish Survey Project has been incorporated into existing monitoring programs through partnerships with government agencies, scientists, conservation organizations, and private institutions. REEF's partners benefit from the educational value and increased stewardship resulting from volunteer data collection. Applications of the data include an evaluation of fish/habitat interactions in the Florida Keys National Marine Sanctuary, the development of a multi-species trend analysis method to identify sites of management concern, assessment of the current distribution of species, status reports on fish assemblages of marine parks, and the evaluation of no-take zones in the Florida Keys. REEF's collaboration with a variety of partners, combined with the Fish Survey Project's standardized census method and database management system, has resulted in a successful citizen science monitoring program.

PMID: 12620003 [PubMed - indexed for MEDLINE]

128: Sports Med. 2003;33(2):109-16.

Asthma and recreational SCUBA diving: a systematic review.

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Asthma has traditionally been a contraindication to recreational self-contained underwater breathing apparatus (SCUBA) diving, although large numbers of patients with asthma partake in diving. The

purpose of this paper is to review all the research relevant to the issue of the safety of asthma in divers. MEDLINE and MDConsult were searched for papers between 1980-2002. Keywords used for the search were 'asthma', 'SCUBA' and 'diving'. Additional references were reviewed from the bibliographies of received articles. A total of fifteen studies were identified as relevant to the area. These included three surveys of divers with asthma, four case series and eight mechanistic investigations of the effect of diving on pulmonary function. The survey data showed a high prevalence of asthma among recreational SCUBA divers, similar to the prevalence of asthma among the general population. There was some weak evidence for an increase in rates of decompression illness among divers with asthma. In healthy participants, wet hyperbaric chamber and open-water diving led to a decrease in forced vital capacity, forced expired volume over 1.0 second and mid-expiratory flow rates. In participants with asymptomatic respiratory atopy, diving caused a decrease in airway conductivity. There is some indication that asthmatics may be at increased risk of pulmonary barotrauma, but more research is necessary. Decisions regarding diving participation among asthmatics must be made on an individual basis involving the patient through informed, shared decision making.

Publication Types: Review
PMID: 12617690 [PubMed - indexed for MEDLINE]

129: J Exp Biol. 2003 Apr;206(Pt 7):1153-61.

Diving experience and the aerobic dive capacity of muskrats: does training produce a better diver?

MacArthur RA, Weseen GL, Campbell KL.

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We tested the hypothesis that the body oxygen stores, aerobic dive limit (ADL) and dive performance of muskrats can be enhanced by dive-conditioning in a laboratory setting. We compared several key variables in 12 muskrats trained to swim a 16 m underwater course to a

feeding station ('divers') with those of 12 animals precluded from diving but required to travel identical distances in water to feed ('surface swimmers'). Acclimated muskrats assigned to each group were trained concurrently over a 9-11 week period. We observed significant gains in the haematocrit ($P=0.0005$) and blood haemoglobin concentration ($P=0.015$) of 'divers', but not 'surface swimmers'. The post-training blood O₂ store calculated for 'divers' (22.9 ml O₂ kg⁻¹) was nearly 26% higher than that (18.2 ml O₂ kg⁻¹) derived for 'surface swimmers' ($P=0.03$). Dive-conditioning had no apparent effect on lung volume, whole blood and plasma volumes, nor on the glycogen level and buffering capacity of skeletal muscles. Cardiac and skeletal muscle myoglobin levels were also similar in both test groups following training. The mean total body oxygen store of 'divers' (37.8 ml O₂ STPD kg⁻¹) was 13.5% higher ($P=0.037$) than for 'surface swimmers' (33.3 ml O₂ STPD kg⁻¹), an increase attributed entirely to the gain in blood O₂ storage capacity of the former group. However, owing to a slightly higher estimate of diving metabolic rate in dive-conditioned animals, the calculated ADL for this group (61.3 s) was indistinguishable from that of 'surface swimmers' (61.8 s). Few differences were observed in the post-training dive behaviour of 'surface swimmers' and 'divers', a finding consistent with the strong similarity in their calculated aerobic dive capacities.

PMID: 12604575 [PubMed - indexed for MEDLINE]

130: Arch Med Res. 2003 Jan-Feb;34(1):26-30.

Differential diagnostic problems of decompression sickness--examples from specialist physicians' practices in diving medicine.

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It can be expected that the differential diagnosis problem of decompression sickness will increase in the future due to the increasing number of divers. During the last 30 years, 232 divers were treated for

decompression sickness (DCS) at the Naval Medical Institute (NMI) in Split, Croatia. In 66 cases (28%), physicians at various diving sites reached diagnosis with difficulty, and 86 divers (37%) came directly to the NMI without seeing a physician first. Physicians at remote diving locations frequently have only basic knowledge of diving medicine and are often inexperienced. The language barrier was a major obstacle in obtaining a medical history and examination of foreign divers. Consultations at the NMI proved a major contribution to correct diagnosis and treatment. We present six illustrative cases from NMI Archives that demonstrate how prejudices, panic, and inexperience could create problems in establishing DCS diagnosis.

Publication Types: Case Reports
PMID: 12604371 [PubMed - indexed for MEDLINE]

131: Ultrasound Med Biol. 2003 Jan;29(1):119-25.

High-frequency sound transmissions under water and risk of decompression sickness.

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We tested the possible occurrence of a neurological insult secondary to high-frequency sound exposure. Immersed, anesthetized rats were subjected to a simulated diving profile designed to induce decompression sickness, while exposed to the transmission of an acoustic beacon. Intermittent sound at a pressure level of 184.5 dB re 1 microPa at 1 m (1.7 kPa), a frequency of 37 kHz, and with a duration of 4 ms, was transmitted in a duty cycle of 0.26%. Four groups, each containing nine animals, were included in the study as follows: group 1, immersion only, no sound exposure; group 2, immersion with sound exposure; group 3, diving simulation when immersed, no sound exposure; group 4, diving simulation when immersed, with sound exposure. Somatosensory evoked potentials (SSEPs) were recorded the day before the study, and a second recording was made 30 min after immersion. Some of the SSEP components disappeared after the dive in 3 rats

from group 3 and 2 rats from group 4. SSEP components could not be identified in a significantly larger number of animals from groups 3 and 4, compared with groups 1 and 2. No differences were found in wave latency, amplitude or conduction time. Our data show that the high-frequency sound exposure employed did not contribute to the development of the neurological insult. Copyright 2003 World Federation for Ultrasound in Medicine & Biology
PMID: 12604123 [PubMed - indexed for MEDLINE]

132: Headache. 2003 Mar;43(3):294-5. Erratum in: Headache. 2003 Oct;42(9):1024.

Is cardiac evaluation for a possible right-to-left shunt indicated in a scuba diver with migraine with aura? Evans RW, Wilmshurst P, Nightingale S.

Publication Types: Case Reports
PMID: 12603652 [PubMed - indexed for MEDLINE]

133: Aviat Space Environ Med. 2003 Feb;74(2):184-6.

Multiple sclerosis presenting as neurological decompression sickness in a U.S. navy diver.

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A case of clinically definite multiple sclerosis presenting as neurological decompression sickness is presented. A 23-yr-old U.S. Navy diver experienced onset of hypesthesia of the left upper trunk approximately 19 h after making two SCUBA dives. She did not seek medical attention until 3 wk later, at which time she was diagnosed with possible neurological decompression sickness. She was treated with hyperbaric oxygen, but demonstrated no improvement. Further evaluation led to the diagnosis of multiple sclerosis. This case underscores the potential similarity in neurological presentation between multiple sclerosis and decompression sickness. The differential diagnosis of neurological decompression sickness, particularly in atypical cases, should include multiple sclerosis. The appropriateness of medically clearing multiple

sclerosis patients for diving is discussed.

Publication Types: Case Reports
PMID: 12602452 [PubMed - indexed for MEDLINE]

134: J Appl Physiol. 2003 Jun;94(6):2249-54. Epub 2003 Feb 21. Cardiovascular responses to apneic facial immersion during altered cardiac filling.

Journey WS, Rardon FD, Kenny GP. Human Performance and Environmental Medicine Research Laboratory, School of Human Kinetics, Faculty of Health Sciences, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5.

The hypothesis that reduced cardiac filling, as a result of lower body negative pressure (LBNP) and postexercise hypotension (PEH), would attenuate the reflex changes to heart rate (HR), skin blood flow (SkBF), and mean arterial pressure (MAP) normally induced by facial immersion was tested. The purpose of this study was to investigate the cardiovascular control mechanisms associated with apneic facial immersion during different cardiovascular challenges. Six subjects randomly performed 30-s apneic facial immersions in 6.0 +/- 1.2 degrees C water under the following conditions: 1) -20 mmHg LBNP, 2) +40 mmHg lower body positive pressure (LBPP), 3) during a period of PEH, and 4) normal resting (control). Measurements included SkBF at one acral (distal phalanx of the thumb) and one nonacral region of skin (ventral forearm), HR, and MAP. Facial immersion reduced HR and SkBF at both sites and increased MAP under all conditions ($P < 0.05$). Reduced cardiac filling during LBNP and PEH significantly attenuated the absolute HR nadir observed during the control immersion ($P < 0.05$). The LBPP condition did not result in a lower HR nadir than control but did result in a nadir significantly lower than that of the LBNP and PEH conditions ($P < 0.05$). No differences were observed in either SkBF or MAP between conditions; however, the magnitude of SkBF reduction was greater at the acral site than at the nonacral site for all conditions ($P < 0.05$). These results suggest that the cardiac parasympathetic response during

facial immersion can be attenuated when cardiac filling is compromised.

Publication Types: Clinical Trial
Randomized Controlled Trial
PMID: 12598488 [PubMed - indexed for MEDLINE]

135: J Acoust Soc Am. 2003 Feb;113(2):1155-65.

The effect of a low-frequency sound source (acoustic thermometry of the ocean climate) on the diving behavior of juvenile northern elephant seals, *Mirounga angustirostris*.

Costa DP, Crocker DE, Gedamke J, Webb PM, Houser DS, Blackwell SB, Waples D, Hayes SA, Le Boeuf BJ. Department of Ecology and Evolutionary Biology and the Institute of Marine Sciences, University of California, Santa Cruz California 95064, USA. costa@biology.ucsc.edu

Changes in the diving behavior of individual free-ranging juvenile northern elephant seals, *Mirounga angustirostris*, exposed to the acoustic thermometry of the ocean climate (ATOC) sound source were examined using data loggers. Data loggers were attached to the animals and measured swim speed, maximum depth of dive, dive duration, surface interval, descent and ascent rate, and descent and ascent angle along with sound pressure level (SPL). The ATOC sound source was at a depth of 939 m and transmitted at 195 dB re: 1 microPa at 1 m centered at 75 Hz with a 37.5-Hz bandwidth. Sound pressure levels (SPL) measured at the seal during transmissions averaged 128 dB and ranged from 118 to 137 dB re: 1 microPa for the 60-90 Hz band, in comparison to ambient levels of 87-107 dB within this band. In no case did an animal end its dive or show any other obvious change in behavior upon exposure to the ATOC sound. Subtle changes in diving behavior were detected, however. During exposure, deviations in descent rate were greater than 1 s.d. of the control mean in 9 of 14 seals. Dive depth increased and descent velocity increased in three animals, ascent velocity decreased in two animals, ascent rate increased in one animal and decreased in another, and dive duration decreased in only one

animal. There was a highly significant positive correlation between SPL and descent rate. The biological significance of these subtle changes is likely to be minimal. This is the first study to quantify behavioral responses of an animal underwater with simultaneous measurements of SPL of anthropogenic sounds recorded at the animal.
PMID: 12597209 [PubMed - indexed for MEDLINE]

136: Brain Res. 2003 Feb 21;964(1):164-7.
Globosa neurons: a distinct subgroup of noradrenergic neurons in the caudal pons of rats.
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A previously undescribed subgroup of A7 neurons was identified and named globosa neurons. Morphologically, these neurons exhibit strong TH staining, are larger and globularly shaped, and are situated more laterally compared with the main group of A7 neurons. They have prominent dendritic processes that are oriented transversely and extend into the lateral lemniscus. These neurons are activated during underwater diving in rats, but at present their function is unknown.
PMID: 12573526 [PubMed - indexed for MEDLINE]

137: J Appl Physiol. 2003 Jun;94(6):2145-50. Epub 2003 Jan 31.
Biophysical basis for inner ear decompression sickness.
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Isolated inner ear decompression sickness (DCS) is recognized in deep diving involving breathing of helium-oxygen mixtures, particularly when breathing gas is switched to a nitrogen-rich mixture during decompression. The biophysical basis for this selective vulnerability of the inner ear to DCS has not been established. A compartmental model of inert gas kinetics in the human inner ear was constructed from anatomical and physiological parameters described in the

literature and used to simulate inert gas tensions in the inner ear during deep dives and breathing-gas substitutions that have been reported to cause inner ear DCS. The model predicts considerable supersaturation, and therefore possible bubble formation, during the initial phase of a conventional decompression. Counterdiffusion of helium and nitrogen from the perilymph may produce supersaturation in the membranous labyrinth and endolymph after switching to a nitrogen-rich breathing mixture even without decompression. Conventional decompression algorithms may result in inadequate decompression for the inner ear for deep dives. Breathing-gas switches should be scheduled deep or shallow to avoid the period of maximum supersaturation resulting from decompression.
Publication Types: Case Reports
Validation Studies
PMID: 12562679 [PubMed - indexed for MEDLINE]

138: J Exp Biol. 2003 Mar;206(Pt 5):833-41.
Corneal power and underwater accommodation in great cormorants (*Phalacrocorax carbo sinensis*).
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In great cormorants (*Phalacrocorax carbo sinensis*), corneal refractive powers, determined by photokeratometry, ranged between 52.1 diopters (52.1 D) and 63.2 D. Photorefractive reflexes, determined by infrared video photorefraction, indicated that in voluntary dives the cormorants accommodate within 40-80 ms of submergence and with myopic focusing relative to the photorefractor attained when prey was approximately one bill length from the plane of the eye. Underwater, the pupils were not constricted and retained diameters similar to those in air. These results support previously reported capacities of lenticular changes in amphibious birds yet do not fully correspond with earlier reports in terms of the coupling of iris constriction with accommodation, and time course.

PMID: 12547938 [PubMed - indexed for MEDLINE]

139: J Neurosurg. 2003 Jan;98(1):180-2.

Barotrauma as a possible cause of aneurysmal subarachnoid hemorrhage. Case report.

Reichardt KA, Nabavi A, Barth H, Mehdorn HM, Blomer U.

Department of Neurosurgery, University Hospital Kiel, Germany.

The authors report the case of a 47-year-old man who suffered a diving accident. After regaining

consciousness he experienced severe headache. He was initially treated for barotrauma, but the persistent

headache led to diagnostic imaging that revealed an aneurysmal subarachnoid hemorrhage. To the

authors' knowledge, this is the first report of a ruptured brain aneurysm associated with barotrauma.

Publication Types: Case Reports
PMID: 12546369 [PubMed - indexed for MEDLINE]

140: Crit Care Med. 2003 Jan;31(1):84-8.

Comment in: Crit Care Med. 2003 Jul;31(7):2083. Crit Care Med.

2004 Sep;32(9):1983; author reply 1983.

Right-to-left shunt and risk of decompression illness with cochleovestibular and cerebral symptoms in divers: case control study in 101 consecutive dive accidents.

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OBJECTIVE: We investigated the role of right-to-left shunt with standardized transcranial Doppler ultrasonography in a large population of divers referred for symptoms of decompression illness.

DESIGN: Case series compared with a control group. SETTING: Military teaching hospital, hyperbaric unit.

PATIENTS: Patients were 101 consecutive divers with clinical evidence of decompression illness and a control group of 101 healthy divers.

INTERVENTION: Specification of the type of decompression illness involved and detection/evaluation of right-to-left shunt by standardized transcranial Doppler. The degree of

right-to-left shunt was defined as major if the number of high-intensity transient signals in the middle cerebral artery was >20.

MEASUREMENTS AND MAIN RESULTS: We evaluated the odds ratios by logistic regression analysis with

vs. without right-to-left shunt for subjects with cochleovestibular symptoms, cerebral decompression

illness, spinal decompression illness, and Caisson sickness. Of the 101 divers presenting with

decompression illness, transcranial Doppler detected a right-to-left shunt in 59 (58.4%), whereas control

subjects demonstrated a right-to-left shunt in 25 cases (24.8%; odds ratio, 4.3; 95% confidence interval, 2.3-7.8; p=.09).

When a right-to-left shunt was detected, the right-to-left shunt was major in 12 of 25 patients in the control group and in

49 of 59 patients in the decompression illness group (odds ratio, 8.7; 95% confidence interval, 4.2-18.0; p<.001).

Within the decompression illness group, the proportion of major right-to-left shunt was 24 of 34 (odds ratio, 29.7; 95% confidence interval, 10.0-

87.2; p<.0001) in the cochleovestibular subgroup, 13 of 21 (odds ratio, 24.1, 95% confidence interval, 6.8-86.0, p< 0.0001) in the cerebral decompression illness

subgroup, ten of 31 (odds ratio, 3.9; 95% confidence interval, 1.5-10.3; p<.01) in the spinal decompression illness subgroup, and

two of two (odds ratio, 1.1; 95% confidence interval, 0.2-5.7; p=.9) in the subgroup of divers with Caisson sickness. CONCLUSION: Based

on our results, we conclude that major right-to-left shunt was associated with an increased incidence of cochleovestibular and cerebral decompression illness, suggesting paradoxical embolism as a potential mechanism.

PMID: 12544998 [PubMed - indexed for MEDLINE]

141: Auton Neurosci. 2003 Jan 31;103(1-2):1-12.

A thermodynamic model of the sympathetic and parasympathetic nervous systems.

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In light of the nonequilibrium thermodynamics by I. Prigogine, the autonomic nervous system as a whole may be viewed as a dissipative structure progressively assembled in the course of evolution, plastically and rhythmically interfaced between forebrain, internal and external environments, to regulate energy, matter and information exchanges. In the present paper, this hypothesis is further pursued to verify whether the two main divisions of the autonomic nervous system, the sympathetic and parasympathetic systems, may support different types of exchange with the external environment. Previous data from hypothalamic stimulation experiments, studies of locus coeruleus function and available data on behavioral functional organization indicate that (1) tight engagement with the external environment, (2) high level of energy mobilization and utilization and (3) information mainly related to exteroceptive sensory stimulation characterize a behavioral prevalence of sympathoadrenal activation. On the other hand, (1) disengagement from the external environment, (2) low levels of internal energy and (3) dominance of proprioceptive information characterize a behavioral prevalence of vagal tone. Behavioral matter exchanges such as feeding, drinking, micturition and defecation are equally absent at the extreme of sympathoadrenal and vagally driven behaviors. The autonomic nervous system as a whole is genetically determined, but the sympathoadrenal system has been mainly designed to organize the visceral apparatus for an action to be performed by the biological system in the external environment and to deal with the novelty of task and of the environment, while the functional role of the parasympathetic is to prepare the visceral apparatus for an action to be performed by the biological system on itself, for recovery and self-protection (homeostasis), and is reinforced by repetition of phylo- and ontogenetically determined patterns. The available clinical data further support this interpretation indicating that an

increased sympathetic and a decreased vagal tone may represent a consistent risk factor for cardiovascular diseases. Copyright 2002 Elsevier Science B.V.
Publication Types: Review
Review, Tutorial
PMID: 12531394 [PubMed - indexed for MEDLINE]

142: Arch Pediatr Adolesc Med. 2003 Jan;157(1):50-3.

Prevalence of traumatic injuries in drowning and near drowning in children and adolescents.

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OBJECTIVE: To determine the prevalence of traumatic injuries in children involved in drowning and near-drowning accidents.

DESIGN/METHODS: Ten-year retrospective medical chart review of patients at an urban tertiary care pediatric facility. Included patients had International Classification of Diseases, Ninth Revision, Clinical Modification codes for fatal/nonfatal drowning or E codes for fall into water, accidental drowning, and submersion. We recorded demographics, event characteristics, diagnostics, and outcome data. We used the chi(2) or the Fisher exact test to compare patients with and without injuries.

RESULTS: One hundred forty-three patients met inclusion criteria. Of these, 95 (66.4%) were male. Median age was 3.8 years, and 30 (23.4%) of 128 had preexisting conditions. Site of drowning was the pool (70.6%), the bathtub (19.0%), or natural water (10.4%). The prevalence of traumatic injury was 4.9% (95% confidence interval, 0%-28%). The predominant mechanism of injury was diving, and all injuries were to the cervical spine. Patients with injury were more likely to be older (mean age, 13.5 vs 5.1 years; $P < .001$) and to have a history of diving (85.7% vs 2.2%; $P < .001$). The presence of injury was not associated with sex, preexisting condition, or site of drowning ($P > .05$). CONCLUSIONS: The prevalence of traumatic injury in drowning and near drowning is low. We identified only cervical spine injuries, and all but 1 patient had

a clear history of diving. Use of specialized trauma evaluations may not be warranted for patients in drowning and near-drowning accidents without a clear history of traumatic mechanism.

PMID: 12517194 [PubMed - indexed for MEDLINE]

143: Thorax. 2003 Jan;58(1):3-13.
British Thoracic Society guidelines on respiratory aspects of fitness for diving.

British Thoracic Society Fitness to Dive Group, Subgroup of the British Thoracic Society Standards of Care Committee.

Publication Types: Guideline
Practice Guideline

PMID: 12511710 [PubMed - indexed for MEDLINE]

144: J Appl Physiol. 2003 Apr;94(4):1485-90. Epub 2002 Dec 13.
Heat stress attenuates air bubble-induced acute lung injury: a novel mechanism of diving acclimatization.
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Diving acclimatization refers to a reduced susceptibility to acute decompression sickness (DCS) in individuals undergoing repeated compression-decompression cycles. We postulated that mechanisms responsible for the acclimatization are similar to that of a stress preconditioning. In this study, we investigated the protective effect of prior heat shock treatment on air embolism-induced lung injury and on the incidence of DCS in rats. We exposed rats (n = 31) to a pressure cycle that induced signs of severe DCS in 48% of the rats, greater wet-to-dry ratio (W/D) of lung weight compared with the control group (5.48 +/- 0.69 vs. 4.70 +/- 0.17), and higher protein concentration in bronchoalveolar lavage (BAL) fluid (362 +/- 184 vs. 209 +/- 78 mg/l) compared with the control group. Rats with DCS expressed more heat shock protein 70 (HSP70) in the lungs than those without signs of disease. Prior heat shock (n = 12) increased the expression of HSP70 in the lung and attenuated the elevation of W/D of lung weight

(5.03 +/- 0.17) after the identical decompression protocol. Prior heat shock reduced the incidence of severe DCS by 23%, but this failed to reach statistical significance ($\chi^2 = 1.94$, $P = 0.163$). Venous air infusion (1.0 ml/40 min) caused profound hypoxemia (54.5 +/- 3.8 vs. 83.8 +/- 3.2 Torr at baseline; n = 6), greater W/D of lung weight (5.98 +/- 0.45), and high protein concentration in BAL fluid (595 +/- 129 mg/l). Prior heat shock (n = 6) did not alter the level of hypoxemia caused by air embolism, but it accelerated the recovery to normoxemia after air infusion was stopped. Prior heat shock also attenuated the elevation of W/D of lung weight (5.19 +/- 0.40) and the increase in BAL protein (371 +/- 69 mg/l) in air embolism group. Our results showed that the occurrence of DCS after rapid decompression is associated with increased expression of a stress protein (HSP70) and that prior heat shock exposure attenuates the air bubble-induced lung injury. These results suggest that bubble formation in tissues activates a stress response and that stress preconditioning attenuates lung injury on subsequent stress, which may be the mechanism responsible for diving acclimatization.

PMID: 12482763 [PubMed - indexed for MEDLINE]

145: J Exp Biol. 2003 Jan;206(Pt 2):303-11.

Tissue-specific expression of inducible and constitutive Hsp70 isoforms in the western painted turtle.

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Expression of Hsp73 and Hsp72 in four tissues of the naturally anoxia-tolerant western painted turtle (*Chrysemys picta*) was investigated in response to a 24 h forced dive and following 1 h recovery. Of the tissues examined, brain and liver displayed approximately threefold and sevenfold higher basal Hsp73 expression than heart and skeletal muscle. Basal Hsp72 expression was relatively low in all tissues examined. After the 24 h forced dive and 1 h recovery, Hsp73 expression

did not differ significantly from basal expression with the exception of liver, where expression decreased significantly after 1 h recovery. Hsp72 expression was unchanged in liver following a 24 h dive; however, it increased twofold in brain and threefold in heart and skeletal muscle. Dive-induced Hsp72 expression was found to correlate inversely with basal Hsp73 expression. Following 1 h recovery, Hsp72 expression was significantly elevated in all tissues above levels in dived animals. These data indicate a tissue-specific pattern of Hsp73 and Hsp72 expression in the western painted turtle during both unstressed and stressed conditions. PMID: 12477900 [PubMed - indexed for MEDLINE]

146: J Exp Biol. 2003 Jan;206(Pt 1):43-57.

Energetics of diving in macaroni penguins.

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Heart rate (fH), abdominal temperature (T(ab)) and diving depth were measured in thirteen free-ranging breeding female macaroni penguins. Measurement of these variables allowed estimation of the mass-specific rate of oxygen consumption ($V(O_2)$) while diving and investigation of the physiological adjustments that might facilitate the diving behaviour observed in this species. In common with other diving birds, macaroni penguins showed significant changes in fH associated with diving, and these variables accounted for 36% of the variation in dive duration. When $V(O_2)$ was calculated for dives of different durations, 95.3% of dives measured were within the calculated aerobic dive limit (cADL) for this species. Mean fH for all complete dive cycles was 147 ± 6 beats min^{-1} . When this fH is used to estimate $V(O_2)$ of 26.2 ± 1.4 ml min^{-1} kg^{-1} then only 92.8% of dives measured were within the cADL. Significant changes in abdominal temperature were not detected within individual dives, though the time constant of the measuring device used may not have been low enough to record these

changes if they were present. Abdominal temperature did decline consistently during bouts of repeated diving of all durations and the mean decrease in T(ab) during a diving bout was 2.32 ± 0.2 degrees C. There was a linear relationship between bout duration and the magnitude of this temperature drop. There was no commensurate increase in dive duration during dive bouts as T(ab) declined, suggesting that macaroni penguins are diving within their physiological limits and that factors other than T(ab) are important in determining the duration of dives and dive bouts. Lowered T(ab) will in turn facilitate lower metabolic rates during diving bouts, but it was not possible in the present study to determine the importance of this energy saving and whether it is occurs actively or passively. PMID: 12456696 [PubMed - indexed for MEDLINE]

147: J Appl Physiol. 2003 Feb;94(2):507-17. Epub 2002 Oct 11.

Effects of age and exercise on physiological dead space during simulated dives at 2.8 ATA.

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Physiological dead space (V_{ds}), end-tidal CO_2 ($P_{et}(CO_2)$), and arterial CO_2 ($P_a(CO_2)$) were measured at 1 and 2.8 ATA in a dry hyperbaric chamber in 10 older (58-74 yr) and 10 younger (19-39 yr) air-breathing subjects during rest and two levels of upright exercise on a cycle ergometer. At pressure, V_d (liters btps) increased from 0.34 ± 0.09 (mean \pm SD of all subjects for normally distributed data, median \pm interquartile range otherwise) to 0.40 ± 0.09 ($P = 0.0060$) at rest, 0.35 ± 0.13 to 0.45 ± 0.11 ($P = 0.0003$) during light exercise, and 0.38 ± 0.17 to 0.45 ± 0.13 ($P = 0.0497$) during heavier exercise. During these conditions, $P_a(CO_2)$ (Torr) increased from 33.8 ± 4.2 to 35.7 ± 4.4 ($P = 0.0059$), 35.3 ± 3.2

to 39.4 +/- 3.1 (P < 0.0001), and 29.6 +/- 5.6 to 37.4 +/- 6.5 (P < 0.0001), respectively. During exercise, Pet(CO(2)) overestimated Pa(CO(2)), although the absolute difference was less at pressure. Capnography poorly estimated Pa(CO(2)) during exercise at 1 and 2.8 ATA because of wide variability. Older subjects had higher Vd at 1 ATA but similar changes in Vd, Pa(CO(2)), and Pet(CO(2)) at pressure. These results are consistent with an effect of increased gas density.
PMID: 12391136 [PubMed - indexed for MEDLINE]