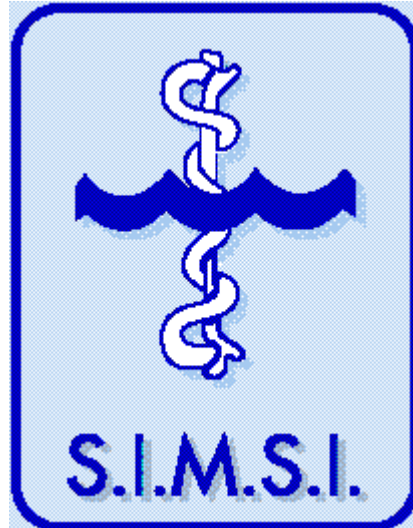
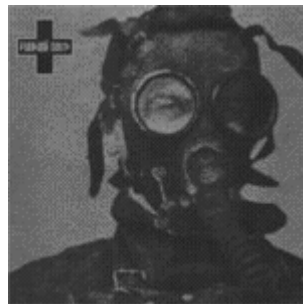


**SOCIETA' ITALIANA
DI
MEDICINA SUBACQUEA E IPERBARICA**



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



**2007
SECONDO SEMESTRE**

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

Search "Diving"[MAJR] Limits: Publication Date from 2007/07 to 2007/12

**Search "Diving"[MAJR] Limits:
Publication Date from 2007/07 to
2007/12**

1: *Accid Anal Prev.* 2008 Mar;40(2):787-97. Epub 2007 Oct 8. Risk factors and prevention for spinal cord injury from diving in swimming pools and natural sites in Quebec, Canada: a 44-year study. Barss P, Djerrari H, Leduc BE, Lepage Y, Dionne CE. Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, Canada. **BACKGROUND:** Diving is the most frequent cause of spinal cord injury (SCI) from recreation and sport in Canada. This study was done to identify risk factors for SCI from diving in the province of Quebec. **METHODS:** An interview survey was done for a target population of 203 subjects with a SCI from diving treated in the two specialized rehabilitation centers in Quebec during 1961-2004. Telephone interviews of consenting individuals were used to collect pertinent personal, equipment, and environmental factors for each incident. **RESULTS:** Response was 44% (89/203); 92% were male and 85% <35 years old. Only 37% were aware prior to injury of the risk of SCI from diving, and only 33% had received water safety training. Swimming pools were the site of 51% (n=45) and natural bodies of water for 49% (n=44). 87% (n=39) of pools were single-unit home pools and 57% (n=26) above-ground. Depth indicators were absent for 100% of above-ground and 74% of in-ground pools. For SCI in in-ground pools, 63% resulted from striking the up-slope between deep and shallow ends. For dives at natural sites, a dock or wharf was the most frequent location, 36% (n=16). In 52% of pools and 79% of natural sites, depth was <1.4m (4.6ft). Signs prohibiting diving were absent in 96% of above-ground and 89% of in-ground pools. Alcohol was reported in 47% of SCIs. **INTERPRETATION:** The target for prevention of diving SCI

is male youths and young adults. Above-ground pools are too shallow and small for diving. Deep ends of many in-ground pools are excessively shallow and short since many SCIs resulted from striking the up-slope. Prevention of SCI from diving needs to focus on education of potential victims, pool vendors and manufacturers, and regulations for safety norms in private pools. Water safety should highlight diving as a high-risk activity, and emphasize that most home pools and natural sites are unsafe. Safer evidence-based pool designs and more effective warnings need to be implemented. PMID: 18329434

2: *Undersea Hyperb Med.* 2007 Nov-Dec;34(6):431-8. Optimization of fin-swim training for SCUBA divers. Wylegala J, Schafer-Owczarzak M, Pendergast DR. Center for Research and Education in Special Environments, Department of Rehabilitation Sciences, University at Buffalo, Buffalo, NY 14214, USA. Underwater swimming is a unique exercise and its fitness is not accomplished by other types of training. This study compared high intensity intermittent fin-swim training (HIIT) with moderate intensity continuous (MICT). Divers (n = 20; age = 23 +/- 4 yrs; weight = 82.57 +/- 10.38 kg; height = 180 +/- 6 cm) were assigned to MICT (65%-75% heart rate max (HRmax), for 45 min) or HIIT three 10 min swims/rest cycles (77%, 83%, and 92% HRmax, respectively) for 50 min. They trained using snorkel and fins at the surface paced by an underwater light system 3 times per week for 4 weeks. Swim tests were the energy cost of swimming, VO2max and timed endurance swim (at 70%/VO2max). The VO2 was a non-significantly reduced at any velocity with either HIIT or MICT. Maximal swim velocity increased after HIIT (10%) (p < or = 0.05) but not after MICT (p > 0.05). VO2max increased 18% after HIIT and 6% after MICT (p < or = 0.05). The endurance times increased 131% after HIIT and 78% after MICT (p < or = 0.05), and in spite of this

post-swim lactate was not significantly different and averaged 4.69 +/- 1.10mM (p > 0.05). Although both training methods significantly improved fin swimming performance with similar time commitments, the HIIT improved VO2max and endurance more than MICT (p < or = 0.05). As no improvements in ventilation were observed, combining HIIT with respiratory muscle training could optimize diver swim fitness.

Publication Types: Randomized Controlled Trial
Research Support, U.S. Gov't, Non-P.H.S.
PMID: 18251440

3: Undersea Hyperb Med. 2007 Nov-Dec;34(6):425-30.

The effect of body position on inspiratory airflow in divers.

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The purpose of this study was to examine the possibility that body position influences inspiratory airflow of submerged subjects. Our previous studies have suggested that for a given (negative) inspired gas pressure, exercising divers experience more dyspnea in the prone than in the upright position.

METHODS: Six subjects performed maximal inspiratory efforts recorded as esophageal pressure (balloon catheter); simultaneously inspiratory flow and lung volumes were recorded. To standardize static lung load, the subjects' chest pressure centroids (representing the average water pressure on the chest) were held at a constant depth (0.33m) throughout the experiments.

RESULTS: Recordings of peak inspiratory flow (PIF) showed a decrease of 25.56 +/- 4.14% (mean +/- SD, P = 0.01) from the submerged upright position mean flow of 6.19 +/- 1.48 (l/s) to the submerged prone mean flow of 4.37 +/- 0.69 (l/s). Nadiral esophageal pressure exhibited no significant differences: 5.40 +/- 4.32% (mean +/- SD, P = 0.512), from the upright mean pressure of (-) 51.70 +/- 24.09 (cm H2O) to the prone mean pressure of (-) 48.53 +/- 25.86 (cm H2O).

CONCLUSIONS: The significant

decrease in PIF when changing from the upright to the prone position, suggests a difference in the patency of the extra-thoracic airways. The higher water pressure exerted on the neck in the prone position may explain this difference. The similarity of pleural pressures in the two positions indicates that the differences in PIF were not due to differences in inspiratory effort.

Publication Types: Randomized Controlled Trial
PMID: 18251439

4: Undersea Hyperb Med. 2007 Nov-Dec;34(6):407-14.

Physiological responses to repeated apneas in underwater hockey players and controls.

Lemaître F, Polin D, Joulia F, Boutry A, Le Pessot D, Chollet D, Tourny-Chollet C.

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The aim of this study was to investigate the effects of short repeated apneas on breathing pattern and circulatory response in trained (underwater hockey players: UHP) and untrained (controls: CTL) subjects. The subjects performed five apneas (A1-A5) while cycling with the face immersed in thermoneutral water. Respiratory parameters were recorded 1 minute before and after each apnea and venous blood samples were collected before each apnea and at 0, 2, 5 and 10 minutes after the last apnea. Arterial saturation (SaO2) and heart rate were continuously recorded during the experiment. Before the repeated apneas, UHP had lower ventilation, higher P(ET)CO2 (p < 0.05) and lower P(ET)O2 than CTL (p < 0.001). After the apneas, the P(ET)O2 values were always lower in UHP (p < 0.001) than CTL but with no difference for averaged P(ET)CO2 (p = 0.32). The apnea response, i.e., bradycardia and increased mean arterial blood pressure, was observed and it remained unchanged throughout the series in the two groups. The SaO2 decreased in both groups during each apnea but the post-exercise SaO2 values were higher in UHP after A2 to A5 than in

CTL ($p < 0.01$). The post-apnea lactate concentrations were lower in UHP than in CTL. These results indicate that more pronounced bradycardia could lead to less oxygen desaturation during repeated apneas in UHP. The UHP show a specific hypoventilatory pattern after repeated apneas, as well as a more pronounced cardiovascular response than CTL. They indeed showed no detraining of the diving response.

PMID: 18251437

5: Undersea Hyperb Med. 2007 Nov-Dec;34(6):399-406.

Erratum in: Undersea Hyperb Med. 2008 Jan-Feb;35(1):2 p preceding 241.

Effect of varying deep stop times and shallow stop times on precordial bubbles after dives to 25 msw (82 fsw).

Bennett PB, Marroni A, Cronje FJ, Cali-Corleo R, Germonpre P, Pieri M, Bonucelli C, Leonardi MG, Balestra C.

Duke University Medical Center, USA. In our previous research, a deep 5-min stop at 15 msw (50 fsw), in addition to the typical 3-5 min shallow stop, significantly reduced precordial Doppler detectable bubbles (PDDB) and "fast" tissue compartment gas tensions during decompression from a 25 msw (82 fsw) dive; the optimal ascent rate was 10 msw (30 fsw/min). Since publication of these results, several recreational diving agencies have recommended empirical stop times shorter than the 5 min stops that we used, stops of as little as 1 min (deep) and 2 min (shallow). In our present study, we clarified the optimal time for stops by measuring PDDB with several combinations of deep and shallow stop times following single and repetitive open-water dives to 25 msw (82 fsw) for 25 mins and 20 minutes respectively; ascent rate was 10 msw/min (33 fsw). Among 15 profiles, stop time ranged from 1 to 10 min for both the deep stops (15 msw/50 fsw) and the shallow stops (6 msw/20 fsw). Dives with 2 1/2 min deep stops yielded the lowest PDDB scores--shorter or longer deep stops were less effective in reducing PDDB. The results confirm that a deep stop of 1 min is too

short--it produced the highest PDDB scores of all the dives. We also evaluated shallow stop times of 5, 4, 3, 2 and 1 min while keeping a fixed time of 2.5 min for the deep stop; increased times up to 10 min at the shallow stop did not further reduce PDDB. While our findings cannot be extrapolated beyond these dive profiles without further study, we recommend a deep stop of at least 2 1/2 mins at 15 msw (50 fsw) in addition to the customary 6 msw (20 fsw) for 3-5 mins for 25 meter dives of 20 to 25 minutes to reduce PDDB.

Publication Types: Validation Studies

PMID: 18251436

6: Rev Mal Respir. 2007 Nov;24(9):1129-32.

["Deep purple": a case of hemoptysis during breath-hold diving]

[Article in French]

Gouzi F, Francois G, Renard C, Jounieaux V.

Service de Pneumologie et Réanimation Respiratoire CHU Amiens Sud, France.

INTRODUCTION: Breath-hold diving has been practised since the dawn of humanity but is open to many risks. The consequences mainly involve the respiratory system. The pathophysiological mechanisms are complex because of the multiple forces applied to the body during breath-hold diving. OBSERVATION: The case reported here describes the development of haemoptysis during a single breath-hold dive to a depth of 26 m, associated with acute alveolar haemorrhage. Recovery was spontaneous. CONCLUSION: This event is rarely described and, although often associated with the more frequently reported pulmonary oedema of immersion, the mechanisms remain uncertain, but definitely multifactorial (barotrauma, thoracic blood transfer) and probably enhanced by deconditioning. All this emphasizes the extraordinary stresses that the alveolo-capillary membrane is subject to under these circumstances.

Publication Types: Case Reports English Abstract

PMID: 18176390

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

Pulmonary gas exchange is reduced by the cardiovascular diving response in resting humans.

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The diving response reduces the pulmonary O₂ uptake in exercising humans, but it has been debated whether this effect is present at rest. Therefore, respiratory and cardiovascular responses were recorded in 16 resting subjects, performing apnea in air and apnea with face immersion in cold water (10 degrees C). Duration of apneas were predetermined to be identical in both conditions (average: 145 s) and based on individual maximal capacity (average: 184 s). Compared to apnea in air, an augmented diving response was elicited by apnea with face immersion. The O₂ uptake from the lungs was reduced compared to the resting eupneic control (4.6 ml min⁻¹kg⁻¹), during apnea in air (3.6 ml min⁻¹kg⁻¹) and even more so during apnea with face immersion (3.4 ml min⁻¹kg⁻¹). We conclude that the cardiovascular adjustments of the diving response reduces pulmonary gas exchange in resting humans, allowing longer apneas by preserving the lungs' O₂ store for use by vital organs.

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

8: Br J Sports Med. 2008 Nov;42(11):634-6. Epub 2007 Dec 7.

Influence of repetitive open sea dives and physical exercises on right-to-left shunting in healthy divers.

Blatteau JE, Pény C, Pontier JM, Gempp E, Louge P.

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OBJECTIVE: Paradoxical gas embolism through right-to-left (R/L) shunts is considered as a potential cause of certain types of decompression sickness. AIM: To assess whether 4 months of repetitive diving and strenuous exercises would lead to an increased prevalence of R/L shunting in a group of military divers.

METHODS: Using a standardised contrast-enhanced transcranial Doppler technique, 17 divers were re-examined for the presence of a R/L shunt 4 months after their initial examinations. R/L shunts were classified as type I if observed only after a straining manoeuvre, and type II if present at rest. RESULTS: Initial prevalence of R/L shunt was 41%: six type I shunts and one type II. At the second examination, prevalence was 47%, with the appearance of one type I shunt that was not previously present. We found no significant increase in the prevalence and size of R/L shunts. CONCLUSION: It is speculated that diving-related phenomena, such as variations in right atrial pressures during the end stages of or events immediately after a dive could generate an R/L shunt. However, extreme conditions of repetitive diving and strenuous exercises do not cause permanent modification in R/L permeability over a period of 4 months.

PMID: 18065441

9: Aviat Space Environ Med. 2007 Dec;78(12):1150-4.

Dysbaric osteonecrosis in experienced dive masters and instructors.

Cimsit M, Ilgezdi S, Cimsit C, Uzun G.

Department of Underwater and Hyperbaric Medicine, Faculty of Medicine, Istanbul University, Istanbul, Turkey.

INTRODUCTION: Dysbaric osteonecrosis (DON) is a type of aseptic bone necrosis of long bones such as the humerus, femur, and tibia. It is observed in workers who perform in high-pressure environments. METHODS: There were 58 volunteer divers included in this study who had performed at least 500 dives, were working as a dive master or instructor, had never performed industrial and commercial dives, and did not have a diagnosis of osteonecrosis. Radiological evaluation was performed according to the guidelines suggested by The British Research Council Decompression Sickness Panel. A total of eight X-rays were taken per patient. When suspicious lesions were detected, MRI of the region was performed. RESULTS: Of the 58

divers, 2 were eliminated because of inadequate X-ray studies. A total of 18 DON lesions were detected in 14 of 56 (25%) divers. Age was the only variable independently associated with the development of DON ($P < 0.05$). DISCUSSION: The DON prevalence of 25% in this study is high considering the dive instructors had thorough diving training and strictly practiced the decompression rules. We believe this high prevalence is a result of frequent and sometimes deep dives for many years. Our findings raise the question of whether these divers can be seen as "sports divers" or should be seen as "occupational divers." If the latter description is approved, dive masters and instructors should be kept under periodic screening for DON lesions just like professional commercial divers to help reduce the morbidity associated with this disease.
PMID: 18064920

10: Aviat Space Environ Med. 2007 Dec;78(12):1114-20.
Antioxidant pretreatment and reduced arterial endothelial dysfunction after diving.
Obad A, Valic Z, Palada I, Brubakk AO, Modun D, Dujic Z.
Department of Physiology, University of Split School of Medicine, Split, Croatia.
INTRODUCTION: We have recently shown that a single air dive leads to acute arterial vasodilation and impairment of endothelium-dependent vasodilatation in humans. Additionally we have found that pre-dive antioxidants at the upper recommended daily allowance partially prevented some of the negative effects of the dive. In this study we prospectively evaluated the effect of long-term antioxidants at a lower RDA dose on arterial endothelial function.
METHODS: Eight professional male divers performed an open sea air dive to 30 msw. Brachial artery flow-mediated dilation (FMD) was assessed before and after diving.
RESULTS: The first dive, without antioxidants, caused significant brachial arterial diameter increase from 3.85 ± 0.55 to 4.04 ± 0.5 mm and a significant reduction of FMD from 7.6 ± 2.7 to $2.8 \pm 2.1\%$. The second dive, with

antioxidants, showed unchanged arterial diameter and significant reduction of FMD from 8.11 ± 2.4 to $6.8 \pm 1.4\%$. The FMD reduction was significantly less with antioxidants. Vascular smooth muscle function, assessed by nitroglycerine (endothelium-independent dilation), was unaffected by diving.
DISCUSSION: This study shows that long-term antioxidant treatment at a lower RDA dose ending 3-4 h before a dive reduces the endothelial dysfunction in divers. Since the scuba dive was of a similar depth and duration to those practiced by numerous recreational divers, this study raises the possibility of routine pre-dive supplementation with antioxidants.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 18064915

11: J Comp Physiol B. 2008 Mar;178(3):321-32. Epub 2007 Dec 7.
Costs of diving by wing and foot propulsion in a sea duck, the white-winged scoter.
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cruciger@uwyo.edu
Most birds swim underwater by either feet alone or wings alone, but some sea ducks often use both. For white-winged scoters (*Melanitta fusca*), we measured costs ($V(O_2)$) of dives to 2 m with descent by feet only versus wings + feet (only feet are used at the bottom). Dive costs repaid during the recovery period after a dive bout were an important fraction (27-44%) of total dive costs, and removing costs of extraneous surface behaviors increased resolution of differences between dive types. Scoters using wings + feet had 13% shorter descent duration, 18% faster descent speed, 31% fewer strokes/m, and 59% longer bottom duration than with feet only. The cost of time underwater for dives using wings + feet was 32-37% lower than with feet only ($P = 0.09$ to 0.15). When indirect methods were used to partition descent costs from costs of ascent and bottom phases, using wings + feet lowered descent cost by an estimated 34%. Thus, using wings + feet increases descent speed and lowers descent cost, leaving more

time and energy for bottom foraging. For birds in cold water, the large savings may result from both biomechanical and thermoregulatory factors.

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

12: J Exp Biol. 2007 Dec;210(Pt 24):4279-85.

Returning on empty: extreme blood O₂ depletion underlies dive capacity of emperor penguins.

Ponganis PJ, Stockard TK, Meir JU, Williams CL, Ponganis KV, van Dam RP, Howard R.

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Blood gas analyses from emperor penguins (*Aptenodytes forsteri*) at rest, and intravascular P(O₂) profiles from free-diving birds were obtained in order to examine hypoxemic tolerance and utilization of the blood O₂ store during dives. Analysis of blood samples from penguins at rest revealed arterial P(O₂)s and O₂ contents of 68±7 mmHg (1 mmHg= 133.3 Pa) and 22.5±1.3 ml O₂ dl⁻¹ (N=3) and venous values of 41±10 mmHg and 17.4±2.9 ml O₂ dl⁻¹ (N=9). Corresponding arterial and venous Hb saturations for a hemoglobin (Hb) concentration of 18 g dl⁻¹ were >91% and 70%, respectively. Analysis of P(O₂) profiles obtained from birds equipped with intravascular P(O₂) electrodes and backpack recorders during dives revealed that (1) the decline of the final blood P(O₂) of a dive in relation to dive duration was variable, (2) final venous P(O₂) values spanned a 40-mmHg range at the previously measured aerobic dive limit (ADL; dive duration associated with onset of post-dive blood lactate accumulation), (3) final arterial, venous and previously measured air sac P(O₂) values were indistinguishable in longer dives, and (4) final venous P(O₂) values of longer dives were as low as 1-6 mmHg during dives. Although blood O₂ is not depleted at the ADL, nearly complete depletion of the

blood O₂ store occurs in longer dives. This extreme hypoxemic tolerance, which would be catastrophic in many birds and mammals, necessitates biochemical and molecular adaptations, including a shift in the O₂-Hb dissociation curve of the emperor penguin in comparison to those of most birds. A relatively higher-affinity Hb is consistent with blood P(O₂) values and O₂ contents of penguins at rest.

Publication Types: Research Support, Non-U.S. Gov't
Research Support, U.S. Gov't, Non-P.H.S.
PMID: 18055617

13: Ecology. 2007 Nov;88(11):2936-45.

Flightlessness and the energetic cost of wing molt in a large sea duck.

Guillemette M, Pelletier D, Grandbois JM, Butler PJ.
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Although the replacement of feathers apparently represents the major event of somatic production in the annual cycle of wild birds, knowledge about the energetics of molt has always been hampered by logistical and technical difficulties, which are exacerbated by the fact that birds are able to compensate behaviorally to buffer any variation in energy demand. During wing molt, sea ducks (Mergini) and other diving birds lose all of their wing feathers at once, leading to a period of temporary flightlessness of variable duration, a condition that considerably restricts their movements and increases the probability of predation. In the present study, we present the first results aimed at quantifying the duration of flightlessness, energy expenditure, and foraging effort during molt of a wing-propelled diving bird, the Common Eider (*Somateria mollissima*). Data loggers were implanted in the body cavity of 13 females to record heart rate and hydrostatic pressure (depth) every two seconds for a period of 220 days. Flight frequency and duration were assessed from elevated and constant heart rate, and the absence

of flight was used to quantify the duration of flightlessness, which lasted, on average, 36 +/- 8 days (mean +/- SD). Using a period of four weeks before and four weeks after the flightless period, we found that dive depth (ranging from 1 to 2 m, on average) and daily diving time did not vary during the course of the study. Daily metabolic rate increased by 9%, and resting metabolic rate by 12% from the pre-molt period to the flightless period and remained high during the post-molt period. This study indicates that the energetic costs of replacing flight remiges in female eiders are substantial, although this is not associated with any change in foraging effort, which suggests that female Common Eiders lose mass during wing molt. Finally, estimates of energy savings associated with the total absence of flights during wing molt represent 6% of daily metabolic rate or 14% of resting metabolic rate. This finding contrasts with the classical view that little or no benefit is associated with a flightless condition. We suggest that such energy savings may have favored the evolution of temporary flightlessness in diving birds.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 18051662

14: Occup Med (Lond). 2007 Dec;57(8):611-2; author reply 612.
Comment on: Occup Med (Lond). 2007 Aug;57(5):349-54.

Health-related quality of life in former North Sea divers.

Ross J, Macdiarmid J, Osman L, Watt S, Lawson A.

Publication Types: Comment Letter
PMID: 18045980

15: Fiziol Cheloveka. 2007 Sep-Oct;33(5):102-12.

[Effects of various hyperbaric gas mixtures on metabolic parameters of human blood]

[Article in Russian]

Buravkova LB, Popova IuA.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 18038668

16: Leg Med (Tokyo). 2008 May;10(3):119-24. Epub 2007 Nov 26.

Scuba-diving related deaths in Okinawa, Japan, from 1982 to 2007. Ihama Y, Miyazaki T, Fuke C, Mukai T, Ohno Y, Sato Y.

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We reviewed the autopsies of scuba-diving related deaths (SDRDs) that were collected from April 1982 until March 2007. In the period under consideration, a total of 40 SDRDs were registered, out of which 34 were males and 6 females. Ages ranged from 19 to 65 years, with the average of 41.5 years (SD=12.9). Divers over the age of 40 accounted for 60% of all fatalities. The major cause of death was drowning (62.5%), followed by disease (28.5%). The average age for drowning and disease-related deaths was 38.6 (SD=12.8) and 48.7 years (SD=10.1), respectively. Of the 40 fatalities, 24 were beginners who had little or no experience. In this study, we compared SDRDs in the first term, from April 1982 to March 1995, and in the second term, from April 1995 to March 2007. The average age in the first and second terms was 35.4 and 45.2 years, respectively; the average age for the second term was 10 years older than the first. Of those in the first term, 13.3%, and of those in the second term, 40.0%, died from complications arising from already existing conditions. This study revealed that the onset of diseases during diving frequently causes fatal accidents, especially for older divers.

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

17: Undersea Hyperb Med. 2007 Sep-Oct;34(5):349-57.

Neurological manifestations of decompression illness in recreational divers - the Cozumel experience.

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Neurological signs and symptoms are common in recreational divers with decompression illness (DCI). The

spectrum of neurological manifestations, temporal profile, and laboratory findings are described in a large series of 200 consecutive recreational divers treated for DCI. The Hyperbaric Medicine Unit charts of 200 recreational divers treated for DCI were reviewed and analyzed. The cohort was mainly male, with a median age of 40 years, and quite experienced, with a median of 100 prior dives. In 44 divers (22%) a rapid ascent was documented. The median time to onset of neurological symptoms was 60 minutes after surfacing. One hundred seventy-seven of 200 divers (88.5%) had at least one symptom of neurological DCI at presentation. The most common neurological manifestations were paresthesia, dysesthesia, incoordination, motor weakness, and dizziness. Paresthesias were associated with significantly younger ($p = 0.003$) and less experienced ($p = 0.03$) divers. Similar but less significant correlations were noted for dysesthesias. Female divers were significantly more likely to experience painful skin symptoms ($p < 0.001$). Neurological manifestations are common in recreational divers treated for DCI. Neurological DCI and paresthesias are more likely to occur in younger and less experienced divers.

Publication Types: Research Support, N.I.H., Extramural Research Support, Non-U.S. Gov't
PMID: 18019086

18: Undersea Hyperb Med. 2007 Sep-Oct;34(5):341-8.

Ventilatory gas analysis in SCUBA divers using a surface-based measurement system.

Jones RL, Docherty D, Gaul CA, Goulet LL, McFadyen PF, Hartley TC, Petersen SR.

Department of Medicine, University of Alberta.

The main technological problem associated with measuring gas exchange in submerged divers breathing from a self-contained underwater breathing apparatus (SCUBA) involves simulating ambient water pressure on the expired side of the SCUBA regulator without causing regulator free-flow. This report presents a method to acquire

expired gas from exercising divers for analysis at the surface using a standard metabolic measurement system. We did this using a flat collapsible tube downstream from the expiration valve of the regulator. We tested 12 divers while swimming on the surface and during SCUBA at 1.8 m (6 ft) underwater using a tethered swim/counter weight system to provide graded exercise to exhaustion. Peak minute ventilation was not significantly different between surface swimming and SCUBA, but peak oxygen consumption (VO_2) was lower ($p < 0.0001$) during SCUBA than for surface swimming. There was a significant correlation ($p = 0.0002$) between peak VO_2 during SCUBA and surface swimming. These results show that VO_2 and ventilation can be accurately measured in SCUBA divers during underwater exercise and the new and simple technique will be useful to those interested in the energy requirements of diving activities in shallow water.

Publication Types: Evaluation Studies Research Support, Non-U.S. Gov't
PMID: 18019085

19: Aviat Space Environ Med. 2007 Nov;78(11):1029-34.

Breath-hold time during cold water immersion: effects of habituation with psychological training.

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INTRODUCTION: The loss of the conscious control of respiration on whole body cold water immersion (CWI) can result in the aspiration of water and drowning. Repeated CWI reduces the respiratory drive evoked by CWI and should prolong breath-hold time on CWI (BHmax(CWI)). Psychological skills training (PST) can also increase BHmax(CWI) by improving the ability of individuals to consciously suppress the drive to breathe. This study tested the hypothesis that combining PST and repeated CWI would extend BHmax(CWI) beyond that seen following only repeated CWI. METHODS: There were 20 male subjects who completed two 2.5-min, head-out breath-hold CWI (BH1

and BH2) in water at 12 degrees C. Following BH1, subjects were matched on BHmax(CWI) and allocated to a habituation (HAB) group or a habituation plus PST group (H+PST). Between BH1 and BH2 both experimental groups undertook five 2.5-min CWI on separate days, during which they breathed freely. The H+PST also received psychological training to help tolerate cold and suppress the drive to breathe on immersion to extend BHmax(CWI). RESULTS: During BH1, mean BHmax(CWI) (+/- SD) in the HAB group was 22.00 (10.33) s and 22.38 (10.65) s in the H+PST. After the five free-breathing CWI, both groups had a longer BHmax(CWI) in BH2. The HAB group improved by 14.13 (20.21) s, an increase of 73%. H+PST improved by 26.86 (24.70) s, a 120% increase. No significant differences were identified between the groups. CONCLUSION: Habituation significantly increases BHmax on CWI, the addition of PST did not result in statistically significant improvements in BHmax(CWI), but may have practical significance. PMID: 18018434

20: J Evol Biol. 2008 Jan;21(1):324-9. Epub 2007 Nov 14. Allometry of diving capacities: ectothermy vs. endothermy. Brischoux F, Bonnet X, Cook TR, Shine R. Centre d'Etudes Biologiques de Chizé- CNRS, Villiers en Bois, France. brischoux@cebc.cnrs.fr Body mass positively influences diving capacities in air-breathing vertebrates and has been identified as a key determinant for the evolution of diving. Our review on the relationship between body mass and dive duration (a major parameter of dive performances) encompassed for the first time a wide diversity of air-breathing vertebrates. We included a substantial number of nonavian and nonmammalian diving species belonging to various independent lineages (sea snakes, iguana, turtles and crocodiles). Our analyses suggest that the widely accepted size dependency of dive duration applies with significantly less force in ectotherms compared with endotherms; notably we failed to detect any effect of body mass in ectotherms. We hypothesize that the

absence of tight physiological links between body mass and respiratory demands documented in ectotherms blurred our ability to detect the expected correlation. Further exploration of the evolution of diving physiology may well necessitate adopting novel perspectives to encompass both ectothermic and endothermic modes. Publication Types: Research Support, Non-U.S. Gov't PMID: 18005017

21: Am J Physiol Heart Circ Physiol. 2008 Jan;294(1):H449-55. Epub 2007 Nov 9. Cardiovascular response to acute hypoxemia induced by prolonged breath holding in air. Pingitore A, Gemignani A, Menicucci D, Di Bella G, De Marchi D, Passera M, Bedini R, Ghelarducci B, L'Abbate A. CNR Institute of Clinical Physiology, Via Moruzzi 1, Pisa, Italy. pingi@ifc.cnr.it Prolonged breath hold (BH) represents a valid model for studying the cardiac adaptation to acute hypoxemia in humans. Cardiac magnetic resonance (CMR) allows a three-dimensional, high-resolution, noninvasive, and nonionizing anatomical and functional evaluation of the heart. The aim of the study was to assess the adaptation of the cardiovascular system to prolonged BH in air. Ten male volunteer diving athletes (age 30 +/- 6 yr) were studied during maximal BH duration with CMR. Four epochs were studied: I, rest; II and III, intermediate BH; and IV, peak BH. Oxygen saturation (So(2)), heart rate (HR), blood pressure (BP), systemic vascular resistance (VR), end-diastolic (EDV) and end-systolic volumes (ESV), stroke volume (SV), cardiac output (CO), ejection fraction (EF), maximal elastance index (EL), systolic wall thickening (SWT), and end-systolic wall stress (ESWS) of the left ventricle (LV) were measured in all four BH epochs. Average BH duration was 3.7 +/- 0.3 min. So(2) was reduced (I: 97 +/- 0.2%, range 96-98%, vs. IV: 84 +/- 2.0%, range 76-92%; P < 0.00001). BP, EDV, ESV, SV, CO, and ESWS linearly increased from epochs I to IV, whereas EF, EL, and SWT showed an opposite behavior, decreasing

from resting to epoch IV (all trends are $P < 0.01$). During prolonged BH in air, a marked enlargement of the LV chamber occurs in healthy diving athletes. This response to acute hypoxemia allows SV, CO, and arterial pressure to be maintained despite the severe reduction in LV contractile function.
PMID: 17993602

22: J Appl Physiol. 2008 Jan;104(1):205-11. Epub 2007 Nov 8. Central chemoreflex sensitivity and sympathetic neural outflow in elite breath-hold divers.
Dujic Z, Ivancev V, Heusser K, Dzamonja G, Palada I, Valic Z, Tank J, Obad A, Bakovic D, Diedrich A, Joyner MJ, Jordan J.
Dept. of Physiology, Univ. of Split School of Medicine, Soltanska 2, 21000 Split, Croatia.
zdujic@bsb.mefst.hr
Repeated hypoxemia in obstructive sleep apnea patients increases sympathetic activity, thereby promoting arterial hypertension. Elite breath-holding divers are exposed to similar apneic episodes and hypoxemia. We hypothesized that trained divers would have increased resting sympathetic activity and blood pressure, as well as an excessive sympathetic nervous system response to hypercapnia. We recruited 11 experienced divers and 9 control subjects. During the diving season preceding the study, divers participated in 7.3 +/- 1.2 diving fish-catching competitions and 76.4 +/- 14.6 apnea training sessions with the last apnea 3-5 days before testing. We monitored beat-by-beat blood pressure, heart rate, femoral artery blood flow, respiration, end-tidal CO(2), and muscle sympathetic nerve activity (MSNA). After a baseline period, subjects began to rebreathe a hyperoxic gas mixture to raise end-tidal CO(2) to 60 Torr. Baseline MSNA frequency was 31 +/- 11 bursts/min in divers and 33 +/- 13 bursts/min in control subjects. Total MSNA activity was 1.8 +/- 1.5 AU/min in divers and 1.8 +/- 1.3 AU/min in control subjects. Arterial oxygen saturation did not change during rebreathing, whereas end-tidal CO(2) increased continuously. The slope of the hypercapnic ventilatory and MSNA response was

similar in both groups. We conclude that repeated bouts of hypoxemia in elite, healthy breath-holding divers do not lead to sustained sympathetic activation or arterial hypertension. Repeated episodes of hypoxemia may not be sufficient to drive an increase in resting sympathetic activity in the absence of additional comorbidities.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17991789

23: Res Sports Med. 2007 Jul-Sep;15(3):225-39. Decompression sickness following seawater hunting using underwater scooters.
Thorsen HC, Zubieta-Calleja G, Paulev PE.
Department of Medical Physiology, The Panum Institute, University of Copenhagen, Copenhagen, Denmark.
hcthorsen@dadlnet.dk
Since the 1960s there have been several reports of divers suffering from decompression sickness (DCS) after repetitive breath-hold (BH) diving. In the period from 1995 to 2000 John Batle observed apparent DCS in 30 free divers competing with underwater scooters in the sea around Mallorca. The cases were treated successfully with recompression therapy. Two of the typical diving profiles, described by Batle, have been submitted to calculations with a modified Haldane model: a perfusion limited, symmetrical multitissue/multilevel model. The model predicts that the two dive profiles will lead to DCS as recorded. A third profile, confirmed by reports to avoid DCS, also were accurately predicted. In order to protect free divers, John Batle developed a dive table for repeated BH diving. According to our calculations the Batle table does not prevent DCS during prolonged exposures. An alternative range of tables is developed and presented.
PMID: 17987510

24: Res Sports Med. 2007 Jul-Sep;15(3):213-23. High altitude diving depths.
Paulev PE, Zubieta-Calleja G.
Department of Medical Physiology, The Panum Institute, University of Copenhagen, Denmark.
pepaulev@yahoo.dk

In order to make any sea level dive table usable during high altitude diving, a new conversion factor is created. We introduce the standardized equivalent sea depth (SESD), which allows conversion of the actual lake diving depth (ALDD) to an equivalent sea dive depth. SESD is defined as the sea depth in meters or feet for a standardized sea dive, equivalent to a mountain lake dive at any altitude, such that [image omitted] [image omitted] [image omitted] Mountain lakes contain fresh water with a relative density that can be standardized to 1,000 kg m⁻³, and sea water can likewise be standardized to a relative density of 1,033 kg m⁻³, at the general gravity of 9.80665 m s⁻². The water density ratio (1,000/1,033) refers to the fresh lake water and the standardized sea water densities. Following calculation of the SESD factor, we recommend the use of our simplified diving table or any acceptable sea level dive table with two fundamental guidelines: 1. The classical decompression stages (30, 20, and 10 feet or 9, 6, and 3 m) are corrected to the altitude lake level, dividing the stage depth by the SESD factor. 2. Likewise, the lake ascent rate during diving is equal to the sea ascent rate divided by the SESD factor.

PMID: 17987509

25: Res Sports Med. 2007 Jul-Sep;15(3):201-11.
Risk factors for dive injury: a survey study.
Beckett A, Kordick MF.
Emergency Medicine Residency Program, Resurrection Medical Center, Chicago, Illinois, USA.
Scuba diving is a world sport, but it is not medically regulated. Study objectives sought to identify risk behaviors, preexisting medical conditions, compliance to dive guidelines, and injury patterns of recreational scuba divers. An Internet-based survey examined risk behaviors and diver safety practices. Responses from 682 of 770 (88.6%) divers revealed that 80.6% were certified; 51.7% of certified divers reported diving injuries versus 75.0% for noncertified divers (RR = 1.31; 95% CI: 1.16-1.48; P < 0.001); suspected

decompression symptoms were witnessed by 52.6% of divers; 32.7% of certified divers reported medical problems including hypertension, asthma, diabetes, and epilepsy. No significant differences were observed in injuries among the certified divers based on dive frequency (P = 1.000), medical conditions (P = 0.750), smoking (P = 0.545), alcohol (P = 0.649), or illicit substances use (P = 0.230). Among certified divers, there was a positive association with fewer diving injuries but not with diving frequency, preexisting medical condition(s), smoking, alcohol, or illicit substance use.

PMID: 17987508

26: J Emerg Med. 2009 Jan;36(1):76-7. Epub 2007 Sep 10.
Pneumomediastinum after shallow water diving.
Shah S, Thomas S, Gibb E.
Department of Emergency Medicine, Massachusetts General Hospital, Boston, Massachusetts 02115, USA.
Publication Types: Case Reports
PMID: 17976822

27: Lancet Oncol. 2007 Nov;8(11):954-5.
Bleomycin and scuba diving: where is the harm?
de Wit R, Sleijfer S, Kaye SB, Horwich A, Mead B, Sleijfer DT, Stoter G.
Erasmus University Medical Centre, Rotterdam, Netherlands.
r.dewit@erasmusmc.nl
Publication Types: Letter
PMID: 17976605

28: Saudi Med J. 2007 Nov;28(11):1700-5.
An investigation of corneal integrity in recreational divers.
Oriowo MO.
Department of Optometry, College of Applied Medical Sciences, King Saud University, PO Box 10219, Riyadh 11433, Kingdom of Saudi Arabia.
matoriowo@yahoo.com
OBJECTIVE: To compare the corneal integrity of recreational divers and non-divers. METHODS: The cross-sectional study was conducted at the St. Erik s Eye Hospital, Stockholm, Sweden, between September 2003 and February 2004. Questionnaires were randomly distributed to determine the potential diving and non-diving

participants. After filling the questionnaires and giving informed consent, corneal endothelial photographs were obtained from the right eyes of the study participants (age range, 20-42 years). Aided and unaided visual acuities were obtained using the Snellen acuity chart. RESULTS: One of the divers reported temporary blurred vision immediately after a diving session, which resolved 2 days later. The average median corneal endothelial cell size for the recreational divers was 14.3 microm² larger than that of the non-divers (p=0.43), and the mean endothelial cell density was 95.7 cells/mm² less than the non-divers (p=0.51). CONCLUSION: There are no significant adverse permanent effect of diving on vision amongst the recreational divers. There is an indication of polymegathism and pleomorphism among the divers, however, no significant difference in the corneal morphology of the recreational divers and the non-divers. However, a further investigation with a larger sample size is needed to confirm this.
PMID: 17965793

29: J Appl Physiol. 2007 Dec;103(6):1958-63. Epub 2007 Oct 18.

Spleen and cardiovascular function during short apneas in divers. Palada I, Eterovic D, Obad A, Bakovic D, Valic Z, Ivancev V, Lojpur M, Shoemaker JK, Dujic Z. Department of Physiology, University of Split School of Medicine, Split, Croatia.

We investigated the spleen volume changes as related to the cardiovascular responses during short-duration apneas at rest. We used dynamic ultrasound splenic imaging and noninvasive photoplethysmographic cardiovascular measurements before, during, and after 15-20 s apneas in seven trained divers. The role of baroreflex was studied by intravenous bolus of vasodilating drug trinitrosan during tidal breathing. The role of lung volume was studied by comparing the apneas at near-maximal lung volume with apneas after inhaling tidal volume, with and without cold forehead stimulation. In apneas at near

maximal lung volume, a 20% reduction in splenic volume (P = 0.03) was observed as early as 3 s after the onset of breath holding. Around that time the heart rate increased, the mean arterial pressure abruptly decreased from 89.6 to 66.7 mmHg (P = 0.02), and cardiac output decreased, on account of reduction in stroke volume. Intravenous application of trinitrosan resulted in approximately 6-mmHg decrement in mean arterial pressure, while the splenic volume decreased for approximately 13%. In apneas at low lung volume, the early splenic contraction was also observed, 10% without and 12% with cold forehead stimulation, although the mean arterial pressure did not change or even increased, respectively. In conclusion, the spleen contraction is present at the beginning of apnea, accentuated by cold forehead stimulation. At large, but not small, lung volume, this initial contraction is probably facilitated by downloaded baroreflex in conditions of decreased blood pressure and cardiac output.

Publication Types: Comparative Study
Research Support, Non-U.S. Gov't
PMID: 17947504

30: J Otolaryngol. 2007 Aug;36(4):247-52.

Does scuba diving cause hearing loss? Hizel SB, Muluk NB, Budak B, Budak G.

Department of Pediatrics, Faculty of Medicine, Kirikkale University, Kirikkale, Turkey.

OBJECTIVES: The aim of this prospective study was to investigate the hearing levels and transient evoked otoacoustic emissions (TEOAEs) of scuba divers. METHODS: The study group consisted of 15 scuba divers (9 males, 6 females) and 30 ears. The control group consisted of 15 healthy nondiver patients (9 males, 6 females) and 30 ears. For the study group, total diving duration (TDD), total diving score (TDS), duration after the last dive (DALD), and maximum diving depth (MDD) were obtained by questionnaire. All subjects were evaluated by an otolaryngologic examination, pure-tone and high-frequency audiometry, and transient

evoked otoacoustic emissions (TEOAEs). RESULTS: There was no significant difference between the hearing thresholds and TEOAEs of the study and control groups. For divers, age, higher TDDs and TDSs, and a higher MDD caused an increase in hearing thresholds and a decrease in TEOAEs. When the DALD increased, cochlear functions again achieved nearly normal levels. CONCLUSION: We recommend that divers' hearing levels and cochlear functions be evaluated before diving. Noninfected status and differences in the volume of the mastoid cell system may explain the results of our study.
PMID: 17942040

31: Environ Sci Technol. 2007 Sep 1;41(17):6210-5.

Comment in: Environ Sci Technol. 2007 Sep 1;41(17):5927.

In situ applications of a new diver-operated motorized microsensor profiler.

Weber M, Faerber P, Meyer V, Lott C, Eickert G, Fabricius KE, De Beer D. Max-Planck-Institute for Marine Microbiology, Celsiusstrasse 1, 28359 Bremen, Germany. m.weber@hydra-institute.com

Microsensors are powerful tools for microenvironment studies, however their use has often been restricted to laboratory applications due to the lack of adequate equipment for in situ deployments. Here we report on new features, construction details, and examples of applications of an improved diver-operated motorized microsensor profiler for underwater field operation to a water depth of 25 m. The new motorized profiler has a final precision of 5 microm, and can accommodate amperometric Clark-type microsensors for oxygen and hydrogen sulfide, potentiometric microsensors (e.g., for pH, Ca²⁺), and fiber-optic irradiance microsensors. The profiler is interfaced by a logger with a signal display, and has pushbuttons for underwater operation. The system can be pre-programmed to autonomous operation or interactively operated by divers. Internal batteries supply power for up to 24 h of measurements and 36 h of data storage (max. 64 million data points). Two flexible stands were developed for deployment on uneven or fragile surfaces, such as

coral reefs. Three experimental pilot studies are presented, where (1) the oxygen distribution in a sand ripple was 3-D-mapped, (2) the microenvironment of sediment accumulated on a stony coral was studied, and (3) oxygen dynamics during an experimental sedimentation were investigated. This system allows SCUBA divers to perform a wide array of in situ measurements, with deployment precision and duration similar to those possible in the laboratory.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 17937304

32: Clin Neurol Neurosurg. 2008 Mar;110(3):259-61. Epub 2007 Oct 24. Transient global amnesia after breathing hyperoxic mixtures in otherwise regular dives.

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

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

Publication Types: Case Reports
PMID: 17920188

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

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

Institute of Physical Education,
Health and Leisure Studies, National
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Taiwan. kybcheng@mail.ncku.edu.tw

The role of arms in compliant-
surface jumping for maximizing
backward somersault rotations is
studied using multi-segment models
and is applied to springboard
diving. The surface (springboard) is
modeled by a rigid bar with a
rotational spring with a hinged end
and point mass at the tip. Planar
four- and five-segment human models
are used (with the fifth segment
representing the arms) and are
driven by torque actuators at the
ankle, knee, hip, and shoulder. Each
joint torque is the product of
maximum isometric torque and three
variable functions depending on
instantaneous joint angle, angular
velocity, and activation level,
respectively. Movement simulation
starts from a balanced initial
posture and ends at jump takeoff.
The objective is to find joint
torque activation patterns during
board contact so that the number of
backward rotations in flight is
maximized. Kinematic differences in
jumps with and without arms are
mainly in smaller takeoff vertical
velocity and more flexed knee and
hip in the former. In both jumps,
joint torque/activations are similar
in their minor flexion-full
extension patterns. Maximum hip
torque is larger with arms but
maximum knee torque is larger
without arms. Except at the knee,
more joint work can be done with arm
swing. Total angular momentum is
increased considerably by arm motion
because of its remote contribution.
Consequently segment remote
contributions to total angular
momentum are much larger in jumping
with arms. Shoulder strength helps
generate angular momentum only to a
certain limit. If more work is used
to generate horizontal velocity away
from the board, the amount of total
angular momentum is reduced.
PMID: 17920146

34: J Thorac Cardiovasc Surg. 2007
Oct;134(4):1042-3.
No one is dead until warm and dead.
Iyer A, Rajkumar V, Sadasivan D,
Bruce J, Gilfillan I.
Department of Cardiothoracic
Surgery, Fremantle Hospital, Alma

St, Fremantle WA, Australia.
anandcvts@hotmail.com
Publication Types: Case Reports
PMID: 17903527

35: Endeavour. 2007 Sep;31(3):115-
20. Epub 2007 Sep 19.
Underwater-works: voyages and
visions of the submarine.
Delbourgo J.
History Department, McGill
University, 855 Sherbrooke Street
West, Montreal, Canada.
james.delbourgo@mcgill.ca
What did it mean to go under water
in the early modern period? Diving
bells had been employed since
antiquity, but in the late
seventeenth century spectacular
recoveries from sunken Caribbean
treasure ships prompted renewed
innovation. Edmond Halley's diving
engine of the 1690s tried to make
the depths amenable to the human
senses and practical manipulation.
This striking attempt to create a
dry world under water was part of a
larger Baroque culture of the
submarine that delighted in
astonishing transformations between
wet and dry.
Publication Types: Biography
Historical Article Research
Support, Non-U.S. Gov't
Personal Name as Subject:
Halley E
PMID: 17884167

36: Eur J Appl Physiol. 2007
Dec;101(6):753-9. Epub 2007 Sep 14.
Total haemoglobin mass and spleen
contraction: a study on competitive
apnea divers, non-diving athletes
and untrained control subjects.
Prommer N, Ehrmann U, Schmidt W,
Steinacker JM, Radermacher P, Muth
CM.
Arbeitsbereich Sportmedizin,
Universität, 95440, Bayreuth,
Germany.
In diving mammals splenic
contraction increases circulating
red cell volume, whereas in humans
increased haemoglobin concentrations
have been reported. It is unknown,
however, whether repetitive apnea
diving also comprises an adaptive
increase in total red cell volume as
reported in endurance athletes. The
first aim of the study therefore was
to investigate the effect of
repeated apnea dives on splenic
size and putative red cell release

in trained apnea divers (n = 10) and control subjects (SCUBA divers performing apneas without long-term apnea training, n = 7). Long-term effects of repetitive apnea diving may elevate the oxygen transport capacity by an adaptive increase in total haemoglobin mass as reported in endurance athletes. The second goal, therefore, was to compare the trained apnea divers' and the control divers' total haemoglobin mass (tHb-mass) with that of endurance-trained (n = 9) and untrained (n = 10) non-divers. Before and immediately after a series of five dives to a depth of 4 m in a heated pool, spleen volume was assessed with ultrasound tomography. tHb-mass and plasma volume were measured using the CO-rebreathing method. In the trained apnea divers, repeated apnea dives resulted in a 25% reduction of spleen size (P < 0.001), whereas no significant effect was observed in the control subjects. While tHb-mass did not differ between trained apnea divers, untrained SCUBA divers performing apneas and untrained non-divers, it was 30% lower than in endurance-trained non-divers. We conclude that prolonged apnea training causes marked apnea-induced splenic contraction. In contrast to athletes in endurance sports, the trained apnea divers did not present with increased total haemoglobin mass and, hence, no increase in blood oxygen stores.
PMID: 17874121

37: J Exp Biol. 2007 Oct;210(Pt 19):3344-55.
To what extent might N2 limit dive performance in king penguins?
Fahlman A, Schmidt A, Jones DR, Bostrom BL, Handrich Y.
North Pacific Universities Marine Mammal Research Consortium, UBC Marine Mammal Research Unit, ROOM 247, AERL, 2202 Main Mall, Vancouver, BC, V6T 1Z4, Canada. andreas_fahlman@yahoo.com
A mathematical model was used to explore if elevated levels of N2, and risk of decompression sickness (DCS), could limit dive performance (duration and depth) in king penguins (*Aptenodytes patagonicus*). The model allowed prediction of blood and tissue (central circulation, muscle, brain and fat)

N2 tensions (P(N2)) based on different cardiac outputs and blood flow distributions. Estimated mixed venous P(N2) agreed with values observed during forced dives in a compression chamber used to validate the assumptions of the model. During bouts of foraging dives, estimated mixed venous and tissue P(N2) increased as the bout progressed. Estimated mean maximum mixed venous P(N2) upon return to the surface after a dive was 4.56+/-0.18 atmospheres absolute (ATA; range: 4.37-4.78 ATA). This is equivalent to N2 levels causing a 50% DCS incidence in terrestrial animals of similar mass. Bout termination events were not associated with extreme mixed venous N2 levels. Fat P(N2) was positively correlated with bout duration and the highest estimated fat P(N2) occurred at the end of a dive bout. The model suggested that short and shallow dives occurring between dive bouts help to reduce supersaturation and thereby DCS risk. Furthermore, adipose tissue could also help reduce DCS risk during the first few dives in a bout by functioning as a sink to buffer extreme levels of N2.
Publication Types: Research Support, Non-U.S. Gov't
PMID: 17872988

38: Science. 2007 Sep 14;317(5844):1498-500.
Comment on: Science. 2007 Jul 13;317(5835):196-7.
Coral reefs still in danger from tourism head.
Macpherson R.
Publication Types: Comment Letter
PMID: 17872426

39: MMW Fortschr Med. 2007 Aug 2;149(31-32):15.
[Diagnosis of decompression sickness. Warning signal: aches and abnormal fatigue]
[Article in German]
Liedtke H.
Publication Types: Interview
PMID: 17855842

40: MMW Fortschr Med. 2007 Aug 2;149(31-32):10-3.
[To whom diving should be permitted]
[Article in German]
Neumaier J.
PMID: 17855841

41: MMW Fortschr Med. 2007 Aug 2;149(31-32):13, 15.
[Dangers in diving under and in coming up]
[Article in German]
[No authors listed]
PMID: 17849779

42: Respir Physiol Neurobiol. 2007 Nov 15;159(2):202-10. Epub 2007 Jul 27.

Mechanics of airway and alveolar collapse in human breath-hold diving.

Fitz-Clarke JR.

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A computational model of the human respiratory tract was developed to study airway and alveolar compression and re-expansion during deep breath-hold dives. The model incorporates the chest wall, supraglottic airway, trachea, branched airway tree, and elastic alveoli assigned time-dependent surfactant properties. Total lung collapse with degassing of all alveoli is predicted to occur around 235 m, much deeper than estimates for aquatic mammals. Hysteresis of the pressure-volume loop increases with maximum diving depth due to progressive alveolar collapse. Reopening of alveoli occurs stochastically as airway pressure overcomes adhesive and compressive forces on ascent. Surface area for gas exchange vanishes at collapse depth, implying that the risk of decompression sickness should reach a plateau beyond this depth. Pulmonary capillary transmural stresses cannot increase after local alveolar collapse. Consolidation of lung parenchyma might provide protection from capillary injury or leakage caused by vascular engorgement due to outward chest wall recoil at extreme depths.
PMID: 17827075

43: Br J Sports Med. 2008 Mar;42(3):212-6; discussion 216. Epub 2007 Sep 3.
Effects of hyperbaric exposures on cardiac pacemakers.
Lafay V, Trigano JA, Gardette B, Micoli C, Carre F.

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Data on tolerance of cardiac pacemakers during diving are very scarce. The aim of this study was to test electronic and mechanical tolerances of pacemakers exposed to experimental reproductions of pressures encountered during diving. Two samples each of 20 different models of cardiac pacemakers were exposed to compression during continuous telemetric monitoring. The first sample of each model was exposed to a pressure of 60 metres of sea water (msw). Each second sample was first exposed to a pressure of 30 msw then to 60 msw hyperbaric testing, with a period of 1 month between the two tests. Electronic function and structural integrity of the cans were evaluated. No electronic dysfunction was noted. We merely observed in some devices a transient increase of the pacing rate during pressurisation. No significant deformation of the can ($< \text{ or } = 0.2$ mm) was observed after the 30 msw hyperbaric test. However, after the 60 msw test, more than half of the devices tested were significantly and definitively deformed. These results show that tested pacemakers preserved a normal electronic function up to 60 msw but most of the tested devices demonstrated significant deformations of the pacemaker can for the hyperbaric exposure observed deeper than 30 msw. Without prejudging diving aptitude for implanted pacemaker patients, it therefore seems prudent to advise them against diving beyond 30 msw because of the potential for electronic dysfunction beyond that depth.

Publication Types: Evaluation Studies
Research Support, Non-U.S. Gov't
PMID: 17768160

44: Respir Physiol Neurobiol. 2007 Nov 15;159(2):171-7. Epub 2007 Jul 1.

The air hunger response of four elite breath-hold divers.

Binks AP, Vovk A, Ferrigno M, Banzett RB.

Physiology Program, Department of Environmental Health, Harvard School of Public Health, and Department of

Anesthesiology, Brigham & Women's Hospital, Boston, MA, USA. abinks@une.edu

Normal subjects terminate breath-holds due to intolerable 'air hunger'. We hypothesize that competitive breath-hold divers might have increased tolerance of air hunger. We tested the air hunger (AH) response of four divers who could hold their breath for 6-9 min. Tidal volume and respiratory rate were controlled by mechanical ventilation (ventilation approximately $0.16 \text{ L min}^{-1} \text{ kg}^{-1}$). AH was induced by raising PCO_2 and rated using a visual analog scale whose maximum was defined as intolerable. SpO_2 was maintained at $>97\%$. Three divers reported the same uncomfortable urge to breathe as normal subjects; the slopes of their responses were within normal range. Both resting CO_2 and AH threshold were shifted to higher CO_2 in some divers. Diver 3 was unique amongst neurologically intact subjects we have studied: he denied feeling an urge to breathe, and denied discomfort. We conclude that elite divers' strategies to tolerate intense air hunger are a minor factor in their ability to tolerate long breath-holds.

Publication Types: Research Support, N.I.H., Extramural Research Support, Non-U.S. Gov't
PMID: 17702673

45: Clin Physiol Funct Imaging. 2007 Sep;27(5):268-74.

Cardiovascular changes induced by cold water immersion during hyperbaric hyperoxic exposure.

Boussuges A, Molenat F, Grandfond A, Regnard J, Wolf JP, Galland F, Robinet C.

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The present study was designed to assess the cardiac changes induced by cold water immersion compared with dry conditions during a prolonged hyperbaric and hyperoxic exposure (ambient pressure between 1.6 and 3 ATA and PiO_2 between 1.2 and 2.8 ATA). Ten healthy volunteers were studied during a 6 h compression in a hyperbaric chamber with immersion up to the neck in

cold water while wearing wet suits. Results were compared with measurements obtained in dry conditions. Echocardiography and Doppler examinations were performed after 15 min and 5 h. Stroke volume, left atrial and left ventricular (LV) diameters remained unchanged during immersion, whereas they significantly fell during the dry session. As an index of LV contractility, percentage fractional shortening remained unchanged, in contrast to a decrease during dry experiment. Heart rate (HR) significantly decreased after 5 h, although it had not changed during the dry session. The changes in the total arterial compliance were similar during the immersed and dry sessions, with a significant decrease after 5 h. In immersed and dry conditions, cardiac output was unchanged after 15 min but decreased by almost 20% after 5 h. This decrease was related to a decrease in HR during immersion and to a decrease in stroke volume in dry conditions. The hydrostatic pressure exerted by water immersion on the systemic vessels could explain these differences. Indeed, the redistribution of blood volume towards the compliant thoracic bed may conceal a part of hypovolaemia that developed in the course of the session.

Publication Types: Comparative Study Research Support, Non-U.S. Gov't
PMID: 17697022

46: J Clin Ultrasound. 2007 Oct;35(8):473-6.

Sonographic detection of intrapulmonary shunting of venous gas bubbles during exercise after diving in a professional diver.

Obad A, Palada I, Ivancev V, Valic Z, Fabijanac D, Brubakk AO, Dujic Z. Department of Physiology, University of Split School of Medicine, Split, Croatia.

We report a case of right-to-left intrapulmonary (IP) shunting of venous gas bubbles at a high level of exercise after diving. The diagnosis was made using a 4-chamber view of the heart via echocardiography during exercise. This case is the first in which we could find evidence of IP shunt recruitment during exercise after

diving, and the bubble grade was the highest ever seen in our laboratory. Venous bubbles crossing over through IP shunts during exercise after diving is a very rare event. (c) 2007 Wiley Periodicals, Inc.
Publication Types: Case Reports
PMID: 17676615

47: Eur J Appl Physiol. 2007 Aug;100(6):637-44. Epub 2007 Feb 16. Cardiac and ventilatory responses to apneic exercise.
Wein J, Andersson JP, Erdéus J. Department of Ecology, Biocentre Grindel, Hamburg University, Martin-Luther-King Platz 3, Hamburg, Germany. jens.wein@uni-hamburg.de
This study was to elucidate the physiological effects of dynamic apneas, as performed as a discipline in breath-hold diving for recreational or competitive purposes. Therefore, cardiovascular and respiratory effects of apneas with simultaneously initiated exercise were investigated in ten trained breath-hold divers. They performed maximum duration apneas with face immersion (26 degrees C) under rest and exercise (40 W, 80 W and 120 W) on a cycle ergometer in the laboratory. Apneic time, heart rate (HR), mean arterial pressure (MAP), arterial oxygen saturation and O₂ (.VO₂) and CO₂ exchange were measured. All end-apnea heart rates were lower than corresponding control values. Higher workloads increased the initial rise in HR and delayed the onset of bradycardia. After an initial drop, MAP rose to 150% of control towards the end of apnea. Apneic .VO₂ was reduced by 25% during exercise and by 40% during resting apneas compared to eupneic control values. It was concluded that magnitude and time course of diving bradycardia depend on work intensity. Higher workloads delay the onset and attenuate HR reduction, presumably due to increased sympathetic activity. It was also found that apnea with simultaneously initiated exercise has an O₂ conserving effect compared to eupneic exercise. Although aimed to be a realistic approach to breath-hold diving, the study has certain methodological limitations in terms of body-immersion (hydrostatic pressure effects) and body-cooling effects due to

conduction of the experiments in a laboratory set-up.
PMID: 17661074

48: Eur Arch Otorhinolaryngol. 2007 Oct;264(10):1243-51. Epub 2007 Jul 17.
Otorhinolaryngologic disorders and diving accidents: an analysis of 306 divers.
Klingmann C, Praetorius M, Baumann I, Plinkert PK. Department of Otolaryngology, Head & Neck Surgery (HNO), University of Heidelberg, Im Neuenheimer Feld 400, 69120, Heidelberg, Germany. christoph_klingmann@med.uni-heidelberg.de
Diving is a very popular leisure activity with an increasing number of participants. As more than 80% of the diving related problems involve the head and neck region, every otorhinolaryngologist should be familiar with diving medical standards. We here present an analysis of more than 300 patients we have treated in the past four years. Between January 2002 and October 2005, 306 patients presented in our department with otorhinological disorders after diving, or after diving accidents. We collected the following data: name, sex, age, date of treatment, date of accident, diagnosis, special aspects of the diagnosis, number of dives, diving certification, whether and which surgery had been performed, history of acute diving accidents or follow up treatment, assessment of fitness to dive and special remarks. The study setting was a retrospective cohort study. The distribution of the disorders was as follows: 24 divers (8%) with external ear disorders, 140 divers (46%) with middle ear disorders, 56 divers (18%) with inner ear disorders, 53 divers (17%) with disorders of the nose and sinuses, 24 divers (8%) with decompression illness (DCI) and 9 divers (3%) who complained of various symptoms. Only 18% of the divers presented with acute disorders. The most common disorder (24%) was Eustachian tube dysfunction. Female divers were significantly more often affected. Chronic sinusitis was found to be associated with a significantly higher number of performed dives. Conservative treatment failed in 30%

of the patients but sinus surgery relieved symptoms in all patients of this group. The middle ear is the main problem area for divers. Middle ear ventilation problems due to Eustachian tube dysfunction can be treated conservatively with excellent results whereas pathology of the tympanic membrane and ossicular chain often require surgery. More than four out of five patients visited our department to re-establish their fitness to dive. Although the treatment of acute diving-related disorders is an important field for the treatment of divers, the main need of divers seems to be assessment and recovery of their fitness to dive.

PMID: 17639445

49: Science. 2007 Jul 13;317(5835):196-7.

Comment in: Science. 2007 Sep 14;317(5844):1498-500.

Comment on: Science. 2007 May 4;316(5825):678-81.

A diver's perspective on coral damage.

Karin N.

Publication Types: Comment Letter

PMID: 17626867

50: Biol Lett. 2007 Oct 22;3(5):574-6.

When cormorants go fishing: the differing costs of hunting for sedentary and motile prey.

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Cormorants hunt both benthic (sedentary) and pelagic (motile) prey but it is not known if the energy costs of foraging on these prey differ. We used respirometry to measure the costs of diving in double-crested cormorants (*Phalacrocorax auritus*) foraging either for sedentary (fish pieces) or motile (juvenile salmon) prey in a deep dive tank. Short dives for sedentary prey were more expensive than dives of similar duration for motile prey (e.g. 20% higher for a 10s dive) whereas the reverse was true for long dives (i.e. long dives for motile prey were more expensive than for sedentary prey). Across

dives of all durations, the foraging phase of the dive was more expensive when the birds hunted motile prey, presumably due to pursuit costs. The period of descent in all the dives undertaken appears to have been more expensive when the birds foraged on sedentary prey, probably due to a higher swimming speed during this period.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 17623631

51: Comp Biochem Physiol A Mol Integr Physiol. 2007 Oct;148(2):360-7. Epub 2007 May 21.

Allometric scaling of lung volume and its consequences for marine turtle diving performance.

Hochscheid S, McMahon CR, Bradshaw CJ, Maffucci F, Bentivegna F, Hays GC.

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Marine turtle lungs have multiple functions including respiration, oxygen storage and buoyancy regulation, so lung size is an important indicator of dive performance. We determined maximum lung volumes ($V(L)$) for 30 individuals from three species (*Caretta caretta* $n=13$; *Eretmochelys imbricata* $n=12$; *Natator depressus* $n=5$) across a range of body masses ($M(b)$): 0.9 to 46 kg. $V(L)$ was 114 ml kg^{-1} and increased with $M(b)$ with a scaling factor of 0.92. Based on these values for $V(L)$ we demonstrated that diving capacities (assessed via aerobic dive limits) of marine turtles were potentially over-estimated when the $V(L)$ -body mass effect was not considered (by 10 to 20% for 5 to 25 kg turtles and by >20% for turtles > or =25 kg). While aerobic dive limits scale with an exponent of 0.6, an analysis of average dive durations in free-ranging chelonian marine turtles revealed that dive duration increases with a mass exponent of 0.51, although there was considerable scatter around the regression line. While this highlights the need to determine more parameters that affect the duration-body mass relationship, our results provide a reference point for calculating oxygen storage

capacities and air volumes available for buoyancy control.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 17596981

52: J Comp Physiol B. 2007 Oct;177(7):779-86. Epub 2007 Jun 23. Respiratory properties of blood in flatback turtles (*Natator depressus*).

Sperling JB, Grigg GC, Beard LA, Limpus CJ. School of Integrative Biology, The University of Queensland, 4072, Brisbane, QLD, Australia. jsperling@sib.uq.edu.au

Oxygen equilibrium curves and other respiratory-related variables were determined on blood from the flatback turtle (*Natator depressus*) and, for comparison, on some samples from the loggerhead turtle (*Caretta caretta*). The oxygen carrying capacity of the flatback turtle, 4.9-8.7 mmol l⁻¹ (n = 49), is at the high end of the range in diving reptiles. Oxygen affinity (P₅₀) was similar in both species at 5% CO₂, ranging from 37 to 55 mmHg (43 mmHg +/- 5.3 SD, n = 24, 25 degrees C, pH 7.17) in flatbacks and 43-49 mmHg in loggerheads (46 mmHg +/- 2.0 SD, n = 7, 25 degrees C, pH 7.13), whereas at 2% CO₂, flatbacks had a higher oxygen affinity. The curves differed in sigmoidicity, with Hill n coefficients of 2.8 and 1.9 in flatbacks and loggerheads, respectively. The Bohr effect was small in both the species, consistent with results from other sea turtles. Lactate levels were high, perhaps because the samples were taken from turtles coming ashore to lay eggs. Flatbacks are rarely found in waters deeper than 45 m. It is suggested that they have a respiratory physiology particularly suited to sustain prolonged shallow dives.

Publication Types: Comparative Study
Research Support, Non-U.S. Gov't
PMID: 17588165

53: J Comp Physiol B. 2007 Aug;177(6):687-700. Epub 2007 Jun 19.

Size and distribution of oxygen stores in harp and hooded seals from birth to maturity.

Burns JM, Lestyk KC, Folkow LP, Hammill MO, Blix AS.

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Pinnipeds rely primarily on oxygen stores in blood and muscles to support aerobic diving; therefore rapid development of body oxygen stores (TBO₂) is crucial for pups to transition from nursing to independent foraging. Here, we investigate TBO₂ development in 45 harp (*Pagophilus groenlandicus*) and 46 hooded (*Cystophora cristata*) seals ranging in age from neonates to adult females. We found that hooded seal adults have the largest TBO₂ stores yet reported (89.5 ml kg⁻¹), while harp seal adults have values more similar to other phocids (71.6 ml kg⁻¹). In adults, large TBO₂ stores resulted from large blood volume (harp 169, hood 194 ml kg⁻¹) and high muscle Mb content (harp 86.0, hood 94.8 mg g⁻¹). In contrast, pups of both species had significantly lower mass-specific TBO₂ stores than adults, and stores declined rather than increased during the nursing period. This decline was due to a reduction in mass-specific blood volume and the absence of an increase in the low Mb levels (harp 21.0, hood 31.5 mg g⁻¹). Comparisons with other phocid species suggests that the pattern of blood and muscle development in the pre- and post-natal periods varies with terrestrial period, and that muscle maturation rates may influence the length of the postweaning fast. However, final maturation of TBO₂ stores does not take place until after foraging begins.

Publication Types: Comparative Study
Research Support, Non-U.S. Gov't
Research Support, U.S. Gov't, Non-P.H.S.
PMID: 17576570

54: J Physiol. 2007 Aug 15;583(Pt 1):405; author reply 407. Epub 2007 Jun 14.

Comment on: J Physiol. 2007 Feb 1;578(Pt 3):859-70.

Cardiac changes after SCUBA diving: the evasive shape of right ventricle.

Marabotti C, L'Abbate A, Bedini R.

Publication Types: Comment
Letter
PMID: 17569726

55: J Appl Physiol. 2007 Sep;103(3):823-7. Epub 2007 Jun 7.
Comment in: J Appl Physiol. 2008 May;104(5):1547; author reply 1548.
Effects of glossopharyngeal insufflation on cardiac function: an echocardiographic study in elite breath-hold divers.
Potkin R, Cheng V, Siegel R.
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Glossopharyngeal insufflation (GI), a technique used by breath-hold divers to increase lung volume and augment diving depth and duration, is associated with untoward hemodynamic consequences. To study the cardiac effects of GI, we performed transthoracic echocardiography, using the subcostal window, in five elite breath-hold divers at rest and during GI. During GI, heart rate increased in all divers (mean of 53 beats/min to a mean of 100 beats/min), and blood pressure fell dramatically (mean systolic, 112 to 52 mmHg; mean diastolic, 75 mmHg to nondetectable). GI induced a 46% decrease in mean left ventricular end-diastolic area, 70% decrease in left ventricular end-diastolic volume, 49% increase in mean right ventricular end-diastolic area, and 160% increase in mean right ventricular end-diastolic volume. GI also induced biventricular systolic dysfunction; left ventricular ejection fraction decreased from 0.60 to a mean of 0.30 ($P = 0.012$); right ventricular ejection fraction, from 0.75 to a mean of 0.39 ($P < 0.001$). Wall motion of both ventricles became significantly abnormal during GI; the most prominent left ventricular abnormalities involved hypokinesis or dyskinesis of the interventricular septum, while right ventricular wall motion abnormalities involved all visible segments. In two divers, the inferior vena cava dilated with the appearance of spontaneous contrast during GI, signaling increased right atrial pressure and central venous

stasis. Hypotension during GI is associated with acute biventricular systolic dysfunction. The echocardiographic pattern of right ventricular systolic dysfunction is consistent with acute pressure overload, whereas concurrent left ventricular systolic dysfunction is likely due to ventricular interdependence.
PMID: 17556497

56: Occup Med (Lond). 2007 Aug;57(5):349-54. Epub 2007 Jun 4.
Comment in: Occup Med (Lond). 2007 Dec;57(8):611-2; author reply 612.
Reduced health-related quality of life in former North Sea divers is associated with decompression sickness.
Irgens A, Grønning M, Troland K, Sundal E, Nyland H, Thorsen E.
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BACKGROUND: Diving is associated with long-term effects on several organ systems. AIM: The objective was to investigate the impact of decompression sickness (DCS) and diving exposure on health-related quality of life (HRQL) in former Norwegian North Sea divers. METHODS: HRQL was recorded by a questionnaire in the cohort of 375 Norwegian North Sea divers registered before 1990. Demographic data, relevant health data and data on diving education, history of DCS and SF-36 were recorded in 230 divers. RESULTS: All SF-36 subscores were significantly reduced compared with Norwegian norms. Reduced scores were seen for all scales among divers who reported previous DCS compared to those without DCS. A decreasing trend in scores was seen when comparing no DCS, skin or joint DCS and neurological DCS. There was a decreasing trend in scores related to number of days in saturation and maximal depth. Stratification on DCS showed that the impact of saturation diving was present only in divers with DCS. CONCLUSIONS: HRQL was reduced in this study sample of divers. Having had DCS during the diving career contributed significantly to the reduction in all SF-36 scales, and apparently

neurological DCS has the most pronounced impact. Cumulative diving exposure including days in saturation and maximal depth contributed to a reduced HRQL.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 17548867

57: Eur J Appl Physiol. 2007 Sep;101(1):125-32. Epub 2007 Jun 1. Hematological response and diving response during apnea and apnea with face immersion.

Schagatay E, Andersson JP, Nielsen B. Department of Natural Sciences, Mid Sweden University, 851 70, Sundsvall, Sweden.

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Increased hematocrit (Hct) attributable to splenic contraction accompanies human apneic diving or apnea with face immersion. Apnea also causes heart rate reduction and peripheral vasoconstriction, i.e., a cardiovascular diving response, which is augmented by face immersion. The aim was to study the role of apnea and facial immersion in the initiation of the hematological response and to relate this to the cardiovascular diving response and its oxygen conservation during repeated apneas. Seven male volunteers performed two series of five apneas of fixed near-maximal duration: one series in air (A) and the other with facial immersion in 10 degrees C water (FIA). Apneas were spaced by 2 min and series by 20 min of rest. Venous blood samples, taken before and after each apnea, were analysed for Hct, hemoglobin concentration (Hb), lactic acid, blood gases and pH. Heart rate, skin capillary blood flow and arterial oxygen saturation were continuously measured non-invasively. A transient increase of Hct and Hb by approximately 4% developed progressively across both series. As no increase of the response resulted with face immersion, we concluded that the apnea, or its consequences, is the major stimulus evoking splenic contraction. An augmented cardiovascular diving response occurred during FIA compared to A. Arterial oxygen saturation remained higher, venous oxygen stores were more depleted and lactic acid

accumulation was higher across the FIA series, indicating oxygen conservation with the more powerful diving response. This study shows that the hematological response is not involved in causing the difference in oxygen saturation between apnea and apnea with face immersion.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 17541787

58: HNO. 2007 Jul;55(7):521-3.

[Diving for children: the 3rd Heidelberg Symposium on diving medicine]

[Article in German]

Tetzlaff K.

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Publication Types: Congresses
PMID: 17534587

59: Int J Sports Med. 2007 Oct;28(10):848-52. Epub 2007 May 11. Neuroendocrine and psychological assessment in a guinness 10 days scuba dive.

Revelli L, Addolorato G, D'Amore A, Carrozza C, Giubileo G, Puiu A, Lombardi CP, Bellantone R, Gasbarrini G; Progetto Abissi 2005 Dive Medical Group.

Department of Endocrine Surgery, Catholic University of Rome, Rome, Italy.

This study was designed to evaluate physiological and psychological stress parameters in 2 professional trained scuba divers, using a unique physiopathologic model, offered by the guinness 240 hours scuba dive. Two scuba dive masters have spent 240 hours at 6 - 8 meters depth (26.4 ft) in Ponza Island water (Italy). Blood samples were collected daily in the underwater bell; samples were carried out of water in waterproof bags. Breath samples were collected, measuring ethylene release. Psychological assessment was performed using the State and Trait Anxiety Inventory and the Zung self-rating depression scale. In the studied subjects, cortisol and prolactin showed physiological pulsatile secretion. Breath ethylene didn't exceed normal values. At the start of the study,

no subjects showed high levels of state anxiety, trait anxiety and current depression. Psychometric scales scores remained steady during the diving period and no subjects showed anxiety and/or depression and/or panic symptoms during the time of observation. The present study shows that, although the long-time diving, well trained professional divers did not develop anxiety and/or depression. No subject discontinued the diving due to occurred psychological disorders or systemic events. The present report shows that the long-term diving permanence is possible, at least in well trained scuba divers.
PMID: 17497574

60: Auris Nasus Larynx. 2007 Sep;34(3):361-4. Epub 2007 May 1. Pediatric sudden sensorineural hearing loss after diving. Marchese-Ragona R, Marioni G, Ottaviano G, Gaio E, Staffieri C, de Filippis C. Department of Otolaryngology-Head and Neck Surgery, University of Padua, Via Giustiniani, 2, 35100 Padua, Italy. rmr@unipd.it
OBJECTIVE: Sensorineural hearing loss after diving from a low height has been rarely reported especially in children. METHODS: We present and discuss a new case of pediatric sudden sensorineural hearing loss after diving. RESULTS AND CONCLUSION: Medical and surgical approaches (indications and timing of explorative tympanotomy) to this occurrence are still controversial. Publication Types: Case Reports
PMID: 17475428

61: J Appl Physiol. 2007 Aug;103(2):484-93. Epub 2007 Apr 19. A new class of biophysical models for predicting the probability of decompression sickness in scuba diving. Goldman S. Dept. of Chemistry and the Guelph-Waterloo Physics Institute, Univ. of Guelph, Guelph, Ontario, Canada N1G 2W1. goldman@chembio.uoguelph.ca
Interconnected compartmental models have been used for decades in physiology and medicine to account for the observed multi-exponential washout kinetics of a variety of solutes (including inert gases) both from single tissues and from the

body as a whole. They are used here as the basis for a new class of biophysical probabilistic decompression models. These models are characterized by a relatively well-perfused, risk-bearing, central compartment and one or two non-risk-bearing, relatively poorly perfused, peripheral compartment(s). The peripheral compartments affect risk indirectly by diffusive exchange of dissolved inert gas with the central compartment. On the basis of the accuracy of their respective predictions beyond the calibration regime, the three-compartment interconnected models were found to be significantly better than the two-compartment interconnected models. The former, on the basis of a number of criteria, was also better than a two-compartment parallel model used for comparative purposes. In these latter comparisons, the models all had the same number of fitted parameters (four), were based on linear kinetics, had the same risk function, and were calibrated against the same dataset. The interconnected models predict that inert gas washout during decompression is relatively fast, initially, but slows rapidly with time compared with the more uniform washout rate predicted by an independent parallel compartment model. If empirically verified, this may have important implications for diving practice.
Publication Types: Comparative Study
PMID: 17446410

62: J Physiol. 2007 Jul 15;582(Pt 2):723-30. Epub 2007 Apr 5. Cerebrovascular reactivity to hypercapnia is unimpaired in breath-hold divers. Ivancev V, Palada I, Valic Z, Obad A, Bakovic D, Dietz NM, Joyner MJ, Djicic Z. Department of Physiology, University of Split School of Medicine, Soltanska 2, 21000 Split, Croatia. Hypercapnic cerebrovascular reactivity is decreased in obstructive sleep apnoea and congestive heart disease perhaps as a result of repeated apnoeas. To test the hypothesis that repeated apnoeas blunt cerebrovascular reactivity to hypercapnia, we

studied breath hold divers and determined cerebrovascular reactivity by measuring changes in middle cerebral artery velocity (MCAV, cm s⁻¹) per mmHg change in end-tidal partial pressure of CO₂ (PET, CO₂) in response to two hyperoxic hypercapnia rebreathing manoeuvres (modified Read protocol) in elite breath-hold divers (BHD, n=7) and non-divers (ND, n=7). In addition, ventilation and central (beat-to-beat stroke volume measurement with Modelflow technique) haemodynamics were determined. Ventilatory responses to hypercapnia were blunted in BHD versus ND largely due to lower breathing frequency. Cerebrovascular reactivity did not differ between groups (3.7 +/- 1.4 versus 3.4 +/- 1.3% mmHg⁻¹) in BHD and ND, respectively; P=0.90) and the same was found for cerebral vascular resistance and MCAV recovery to baseline after termination of the CO₂ challenge. Cardiovascular parameters were not changed significantly during rebreathing in either group, except for a small increase in mean arterial pressure for both groups. Our findings indicate that the regulation of the cerebral circulation in response to hypercapnia is intact in elite breath-hold divers, potentially as a protective mechanism against the chronic intermittent cerebral hypoxia and/or hypercapnia that occurs during breath-hold diving. These data also suggest that factors other than repeated apnoeas contribute to the blunting of cerebrovascular reactivity in conditions like sleep apnoea.

Publication Types: Research Support, Non-U.S. Gov't
PMID: 17412771

63: Spinal Cord. 2007 Oct;45(10):687-9. Epub 2006 Nov 28. Blunt cervical spine trauma as a cause of spinal cord injury and delayed cortical blindness. McCormick MT, Robinson HK, Bone I, McLean AN, Allan DB. Department of Neurology, Institute of Neurological Sciences, Southern General Hospital, Glasgow, Scotland, UK.

STUDY DESIGN: Case report.
OBJECTIVE: To present and discuss the case of a patient who sustained

a significant flexion compression injury of the cervical spine with resulting tetraplegia and development of cortical blindness. SETTING: National Spinal Injuries Unit and Institute of Neurological Sciences, Southern General Hospital, Glasgow, Scotland, UK. METHODS: Clinical and radiological follow-up of the patient. RESULTS: Cortical blindness resulted from vertebral artery dissection associated with blunt cervical spine trauma. The patient is registered blind and is ventilator dependent. CONCLUSION: The potential complications of blunt vertebral artery injury remain poorly recognised. Screening is routinely not performed. Advances in noninvasive radiological techniques may result in recognition of asymptomatic disease and the potential for therapeutic intervention.

Publication Types: Case Reports
PMID: 17130891 [PubMed - indexed for MEDLINE]