Diving Medicine Online

Comprehensive information about diving and undersea medicine for the non-medical diver, the non-diving physician and the specialist.

Endocrine and Metabolic Problems

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Diabetes and Diving

Guidelines for Diabetics Who Want to Dive

DAN suggests that some diabetics may dive safely in controlled

settings. The Diabetes and Diving Committee of the Council on Exercise of the American Diabetes Association notes that there are currently a substantial number of diabetics, in the United States and elsewhere, who dive.

Criteria for diving include:
good control of blood glucose levels
freedom from severe secondary complications of diabetes (eyes, kidneys, blood vessels)
an understanding of the relationship between the disease and exercise
Diabetics who shouldn't dive are those who:

have had a serious hypoglycemic episode within the past 12 months
have advanced secondary complications of the disease
have poor control of their blood sugar
are unaware of the early warning signs of hypoglycemia
lack insight into the relationship between diabetes and exercise

UKSDMC recommendations are similar, though more rigorous. A questionnaire must be filled out by the prospective diver, and a separate one completed by the diver's physician. In addition, BSAC has developed guidelines concerning what additional gear and supplies diabetic divers should carry, and proposes a pre- and post-dive plan in order to minimize risks.

The YMCA has an extensive protocol for diabetic scuba divers. It carefully differentiates the divers with mild diabetes and those with frequent changes in blood sugar levels and hypoglycemia.

Links

Diving Programs for Diabetics
PADI Medical Checklist
Doc's Diving Page
Scubamed

DAN Articles on Diabetes & Diving
Blood Glucose Response to Recreational Diving in Insulin-Dependent Diabetics
DAN examines Diabetes Guidelines
Diabetes and Diving -- An article on current practices

Hyperbarics and Diabetes

Dermagraft For Diabetic Foot Ulcers

Dermagraft, a living human dermal replacement for the treatment of diabetic foot ulcers.

Hyperbaric Oxygen Therapy

From the Undersea and Hyperbaric Medical Society, learn about a therapy known to help healing in the case of those with diabetes. Contact information available.

The Role of HBO Therapy in Diabetes

Just how does hyperbaric oxygen therapy relate to a diabetes ulcer or wound? From Wound Care Consultants.

The Thyroid and Diving

The thyroid gland secretes thyroxin which is a hormone that helps control the rate at which we burn up carbohydrates (metabolic rate). Too much thyroxin causes hyperthyroidism (thyrotoxicosis) --- too little causes hypothyroidism (myxedema).

What a diver needs to be concerned with is his/her body's ability to function with the increased work load that hyperthyroidism places on your heart. Add to this increased workload the load of diving with heavy gear and your heart may not be able to handle it, in that the person with hyperthyroidism is prone to having attacks of paroxysmal atrial tachycardia or atrial fibrillation(episodes of rapid heart beating) that can leave the person unconscious or unable to function. This would be disastrous under water, even if you were just skin diving or snorkeling.

Atypical presentation, with cardiac or psychiatric symptoms, is common in men. Patients with thyroid ophthalmopathy frequently have difficulty in upward gaze. Corneal damage and optic neuropathy (inflammation of the optic nerve) can also occur.

Return to diving: Return to diving may be considered once the patient is euthyroid (normal thyroid level) on a stable dose of replacement medication if required. Patients with ophthalmopathy will need to be disqualified while undergoing treatment and may need to be disqualified permanently if

treatment is unsuccessful. Mask damage to the eye is a strong possibility in these situations.

Data required for decision making: Endocrinology consultation, appropriate laboratory studies and ophthalmological consultation is also required if exophthalmos (protrusion of eyes) or other eye conditions are suspected. Annual confirmation of clinical and chemical euthyroid (normal) status is needed for continued diving.

Therapy: There are 3 main forms of therapy: medical treatment with methimazole or similar drugs; radioactive iodine; and surgery. Methimazole may cause side effects including vertigo and drowsiness, as well as agranulocytosis (bone marrow suppression). Diving is contraindicated in when their is bone marrow suppression due to the possibility of increased infections. Surgery is declining in popularity but may be the treatment of choice in females of childbearing age, because of the possibility of ovarian damage from the radioactivity. A small number of cases will require eye surgery.

Notes for consideration of the diver: Muscle pain, weakness and stiffness are the presenting symptoms in 25% of patients. Weakness and tremor can be mistaken for decompression accidents. Bulbar involvement can occur. With drug treatment, there is a 50% relapse rate, some cases relapsing early. With radioactive iodine, 10 to 15% of cases will be hypothyroid (low thyroid condition) within 2 years, and 50 to 60% will be hypothyroid within 20 years. A third of patients undergoing surgery will be hypothyroid within 10 years. Patients therefore have to review regularly for the rest of their lives. The complete remission rate (those that get well) after radioactive iodine is 86% with 60% developing myxedema (puffy swelling of low thyroid condition) after 10 years and a further 2-3% a year

developing myxedema after that. Only 5% of patients with Graves' disease (hyperthyroidism) will have ophthalmopathy (protruding eyes). More than 50% of cases of exophthalmos (protruding eyes) will get better spontaneously within 5 years with no other treatment than that of the underlying condition. Only 5% of patients will require eye surgery.

Nitrox Diving and the Thyroid

Nitrox is the mixture of increased amounts of oxygen in the breathing air of divers. Regular air is 20%; nitroz is mixed in 32%, 36% and higher. This allows for longer bottom times, reduced risks of decompression illness (less nitrogen) but also imposes a penalty of increased risk of oxygen toxicity. Certain drugs are sympathomimetic (mimicking the action of the sympathetic nervous system) and increase the metabolic rate, heart rate and rate at which O2 is utilized. Thyroid hormone, either Synthroid or thyroxin produced by the body or taken by mouth act in this manner. These drugs also have been found to increase the risk of oxygen seizures at shallower depths (pressures).
See Nitrox at http://www.scuba-doc.com/nitrox.htm or http://www.scuba-doc.com/nitroxlnks.html

For a good discussion of thyroid conditions, go to this web page http://www.myweb.cableone.net/dickalf/

To my knowledge there have been no studies that have shown any increased risks to the person with hyperthyroidism, even untreated. However, the prudent person would certainly not dive if his thyroid functions were out of line --- just as he/she should not play tennis or handball or some other physical exercise until

they were "euthyroid" (normal function of the gland). One month of treatment is not usually long enough to become euthyroid -- although I've had patients who have responded rapidly to medication. Your doctor should be the final arbiter in this matter.

Exophthalmos

One other symptom that you need to be aware of is exophthalmos (see above), or protrusion of the eyes. This can occur in one or both eyes in association with a high thyroid condition. If this is a prominent part of your illness, then you need to be concerned with mask squeeze and with irritation of the cornea.

See Eye problems

Chronic Adverse Effects of Diving on Genetics and Reproduction

GENETICS

In a study which was funded by the U.K. Departmentof Energy (Fox et al, 1984) blood was taken from more than 150 divers and an equal number of control subjects. Of 77 compressed air divers and 76 mixed gas divers, 6 had a few heavily damaged

cells. The health risks imposed by these abnormal cells is unknown but the damage they contain is, in most cases, so extreme that they are likely to die at mitosis. No such cells were found in the controls.

This type of finding was unexpected and, because of such low numbers, no correlation was possible with the many associated occupational factors that were also studied. The aberrations observed were typical of those induced by ionizing radiation and were present in air divers as well as mixed gas divers.

In addition, changes have been reported in lymphocytes and heat shock protein expression in divers in the UHMS publication, Undersea and Hyperbaric Medicine.

Undersea Hyperb Med 2000 Spring;27(1):37-41
Hyperbaric stress during saturation diving induces lymphocyte subset changes and heat shock protein expression.

Matsuo H, Shinomiya N, Suzuki S

Department of Microbiology, National Defense Medical College, Tokorozawa, Japan.

To clarify the cellular responses and biochemical markers of hyperbaric stress, we investigated heat shock protein (hsp) expression and subset changes of human peripheral blood lymphocytes during saturation diving. Five healthy male subjects underwent a 39-day saturation dive to the maximal storage pressure of 4.1 MPa [400 meters of sea water (msw)]. During the saturation dive, lymphocyte subset changes were detected using a flow cytometer, and increased expressions of hsp 72/73 and hsp 27 were observed by Western blot analysis. Lymphocyte subset changes included a decrease in CD4:CD8 ratio and in the

fraction of CD4+ T cells as well as an increase in NK cells, especially during the 400-msw bottom phase. An increased expression of hsp 27 compared to hsp 72/73 was obvious, especially during the hold period at 100 msw. These results suggest that changes in lymphocyte subsets and hsp expression are useful markers for stress responses during saturation diving. These changes may also be useful for testing the barotolerance of divers for saturation diving.
Other references to lymphocyte suppression and diving are located at

Shinomiya N, Suzuki S, Hashimoto A, Oiwa H.
Effects of deep saturation diving on the lymphocyte subsets of healthy divers.
Undersea Hyperb Med. 1994 Sep;21(3):277-86.

There are also many other possible long-term effects such as subfertility in animals (Hawley et al, 1986), an effect recently studied in man and reported in the International Journal of Andrology.

Int J Androl 2000 Apr;23(2):116-20
Impact of a deep saturation dive on semen quality.

Aitken RJ, Buckingham D, Richardson D, Gardiner JC, Irvine DS

MRC Reproductive Biology Unit, 37 Chalmers Street, Edinburgh EH3 9ET, Scotland. jaitken@mail.newcastle.edu.au

The demonstration dive 'Aurora' has provided an opportunity to study the impact of extreme hyperbaric conditions on male fertility. This operation involved a 33-day diving programme during which divers were exposed to a maximum pressure of 4.6 Mega Pascals (Mpa) for 7 days. At days - 4, + 27, + 34, + 82

and + 263 relative to the initiation of the dive, semen samples were analysed to determine the quality of spermatogenesis and the functional competence of the spermatozoa. A dramatic fall in semen quality was observed in association with the dive and by day + 82 the potential fertility of the men was seriously compromised as evidenced by oligoasthenoteratozoospermic semen profiles and the poor fertilizing potential of the spermatozoa. These studies indicate, for the first time, that the severe hyperbaric conditions associated with deep saturation dives have a profound effect on male reproductive function.

Diving and fertility

Few areas of military activity seem to generate as much myth and legend as diving. It is a common belief that male divers offspring tend to be female, and the mechanism for this is often quoted as a hyperbaric effect on testicular perfusion. In an unpublished study, Edmonds conducted a retrospective review of Royal Australian Navy divers offspring. Of 240 offspring, 122 were conceived before diving activities, the remaining 118 after the divers received their diving qualifications. Edmonds further divided these groups into air divers and oxygen divers and generated 2 contingency tables that were analysed by chi_2 test. There was no significant difference between the groups and no support for the hypothesis that divers have a propensity to female offspring (Edmonds, quoted by Commander Robyn Walker, personal communication)

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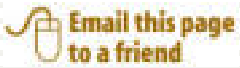

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