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ZASADY RACJONALNEGO ŻYWIENIA NURKÓW

Każdy rodzaj nurkowania; zarówno komercyjne, militarne jak i hobbyistyczne - amatorskie wiąże się z przebywaniem człowieka w krańcowo różnych warunkach środowiska zewnętrznego. Odmienne właściwości fizyczne wody w stosunku do powietrza istotnie wpływają na homeostazę ustroju, stwarzając liczne zagrożenia dla zdrowia i życia nurka. Najistotniejsze z nich to zwiększone i zmienne ciśnienie otaczające wpływające na właściwości fizyczne gazów w ustroju, gęstość środowiska otaczającego zwiększająca opory przy poruszaniu się, wzrost ciśnień parcyjnych składników mieszaniny oddechowej, wielokrotnie większa przewodność cieplna środowiska i wiele, wiele innych.

Nurkowanie zaliczane do prac ciężkich, lub sportów ekstremalnych niesie ze sobą liczne zagrożenia dla zdrowia. Świadomość tych zagrożeń pozwala na ochronę przed nimi. Jedną z form ochrony i dbałości o bezpieczeństwo nurkowania jest racjonalne odżywianie mogące zmniejszyć lub całkowicie wyeliminować niektóre zagrożenia. Odżywianie ma na celu nie tylko dostarczenie energii, lecz również niezbędnych składników odżywczych zapewniających prawidłowe funkcjonowanie

organizmu. Odmienne warunki środowiska wodnego, krańcowo różne w stosunku do normalnego otoczenia człowieka nie pozostają bez wpływu na zasady żywienia nurków, zarówno pod względem kaloryczności, składu posiłków, jak i zasad ich podawania.

Możliwości zmniejszenia ryzyka chorób i wypadków nurkowych związane z prawidłowym odżywianiem nurka są znaczne, choć mimo znajomości ich fizjologicznych podstaw, nadal niedoceniane i rzadko brane pod uwagę przy planowaniu nurkowań. Zależnie od profilu nurkowania dieta nurka ma większy, bądź mniejszy wpływ na jego bezpieczeństwo, jednak zawsze wpływ taki istnieje i powinien być brany pod uwagę.

W zasadach prawidłowego żywienia nurków uwzględnia się przede wszystkim znacznie zwiększone zapotrzebowanie energetyczne ustroju, ale także przeciwdziałanie odwodnieniu, hamowanie oddziaływania wolnych rodników, redukcję stresu dekompresyjnego, możliwość wystąpienia narkozy gazów obojętnych, eliminację ryzyka urazu ciśnieniowego jelit i inne zagrożenia.

Słowa kluczowe: nurek, odżywianie, zagrożenia

RULES OF DIVER'S RATIONAL DIET

Each type of diving: commercial, military and for hobby - amateur is connected with time spent in various extreme conditions in the external environment. Different physical properties of water in comparison with air affect significantly the homeostasis of the body, creating a number of threats for health and life of a diver. The most important of these is the increasing and changeable pressure of the surrounding, affecting the physical properties of gases in the system, the density of the environment that rise the resistance during movement, the increase in partial pressure of the breathing mixture, the huge increase in the thermal conductivity of the environment, and much more.

Diving, that is classified as heavy work, or extreme sport, is risky for our health. Awareness of these threats helps us to protect against them. One form of protection and care for the safety of diving is a reasonable diet that may reduce or completely eliminate some of the risks. Nutrition aims to provide not only energy but also essential nutrients to ensure proper functioning of the body. Radically different conditions of the aquatic environment in comparison with the normal human environment are not without influence on the nutrition principles for divers in terms of calories as well as the composition of meals and rules for feeding.

Possibility of reducing the risk of diseases and accidents associated with the diver's proper nutrition is considerable but still undervalued and rarely taken into account while dive planning, despite the knowledge of the physiological bases. Depending on the dive profile, diver's diet has a greater or lesser influence on his safety, but there is always such an influence and it should be taken into account.

Primly, in terms of divers' nutrition, substantially increasing energy demands of the system should be included, but also it should be considered in aims to prevent dehydration, inhibiting the effects of free radicals, reducing stress, decompression, the possibility of inert gas narcosis, eliminating the risk of bowel injury, pressure and other threats.

Key words: diver, nutrition, hazards

INTRODUCTION

One of the most important factors in the proper functioning of the human body and health system at any age is the diet. Well-composed diet is very important and effective part of prevention of diseases caused by faulty diet. The proper functioning of the human body needs various nutrients. Some of them may itself be prepared from other compounds in food, but options are limited. Therefore, most of the ingredients must be supplied in the diet. Proper nutrition is composed of many factors. Above all, it is important to remember about the proper selection of products that not only provide the body with adequate amount of calories, but also with essential nutrients. The proper functioning of the human body needs 5 basic groups of nutrients: proteins, fats, carbohydrates, vitamins and minerals. All food components in the body constantly evolve and continuously exchange. This process is called metabolism. Basic metabolic energy expenditure is connected with the body vital functions. Secondary metabolic energy expenditure is associated with the provision of physical and mental work. The total metabolism is a determinant of the human body energy needs and it is dependent on many factors as: age, body weight, gender, physiological state and greatly on the type of work. Heavier the muscles work, greater energy is demanded. Demanding of energy also depends on the season, ambient temperature and the individual characteristics of the organism. There should be a perfect balance between the energy value of food and energy demand of the organism. If the energy value of food exceeds the body demand for energy, excess of the components will be deposited in the form of fat, which leads to obesity. However, food shortages may lead to emaciation, and even destruction of the body. Another important principle of a balanced diet is that the variety of food provided to the body is needed, because there is no universal product that provides the essential nutrients for all.

HEALTH HAZARDS IN DIVING

Diver's health is influenced by many factors, both subjected to diver's behavior and external ones. General health, nutritional status, diet, physical factors related to diving: temperature, pressure and respiratory factor are the most important.

Different conditions of the aquatic environment, radically different in comparison with the normal human environment are not without influence on the divers' nutrition principles, in terms of calories as well as the composition of meals and rules of feeding. The daily caloric requirement of a diver is the sum of basic metabolism and functional and work energy expenditure. While the basic energy needs of the organism does not differ in the case of divers from the average value of the population, the demand for functional expenditure, especially that connected with work, differs significantly in relation to the function at the surface. It is connected not only with more movement at work in an extremely dense aquatic environment, but also with higher heat loss. It is assumed that most forms of diving-related activities should be classified as mid-hard physical exercise, while the submarine work and diving in extreme conditions should be classified as a very hard work. Energy demand in case of hard work rises about 300-600 kcal / h in relation to the demand on the surface, which increases the daily caloric needs of a diver by 50-100% depending on diving time per day, a nutritional daily quota should be about 5000 kcal [5].

We should also pay attention to the relationship to the risk of eating disorders and diving accidents, such as pressure disease, nitrogen narcosis and pressure bowel disorders.

Decompression Illness (DCS), called also the pressure or caisson, is the biggest threat of all dives. DCS is a single symptom or syndrome, which occurs because of the gas bubbles in the body, from the desaturation of body fluids and tissues. Direct cause of symptoms is the difference between the diameter of the bubble gas and light in a blood vessel.

All the symptoms of DCS are related to the pressure of the liquid desaturation, that means that the gas bubbles occurred in the blood and other tissues, and by their presence they cause a pressure on important organs, or combining with one another in the larger structures obstruct the blood vessels. The formation of bubbles in the tissues during decompression may lead to a variety of symptoms or may remain asymptomatic. Condition in which gas bubbles are present in blood and other tissues and they do not cause any clinical signs of stress is called decompression. Although they do not always lead to onset of pressure disease (DCS), their presence is not entirely indifferent to the body system. Besides the possibility of gas blockages that are purely mechanical, gas bubbles are for the body as a foreign body in the bloodstream and on the border of liquid and gas phase they cause different reactions. During decompression the fat tissues may be damaged and lipids or entire adipocytes may be released into the bloodstream and they may impose a gas embolism, with the difference that the treatment of decompression-recompression makes no therapeutic effects.

Elevated level of fats in the blood by increasing the solubility of gas, definitely increases the risk of decompression stress. The constant presence of a certain amount of fat in the peripheral blood, and in the excessive consumption of fat or because of their abnormal metabolism, sometimes connected with quite high concentrations, strongly affects the incomplete decompression, even if the decompression tables are used correctly. Circulating lipids in peripheral blood are a major source of easily available gas solvent, due to the transport role of the blood and therefore they increase the risk of decompression sickness. In addition, a long time of the metabolism of fats in the body (an average of 16 hours) conducive to increase the level of lipids in the blood steadily. Therefore, it is important that the divers' diet should have a low level of fat.

There is other problem with nutrition, connected with the dishes that may cause flatulence that may be the cause of pressure bowel disorder. Intestine light is "closed" area for the gas, which is more or less filled with gases. In the course of diving under the influence of pressure the compression of gases happens, and because of the fact that guts transport contents during dives, there is a change in the volume of gas voids. During the surfacing an incapacitating gases may not have enough free space and because of it they may cause intestinal distension, and in extreme cases, the perforation. At the time of increasing diving activity, consumption of products that increase the amount of gas is not recommended but it is very important to take care of regular defecation.

Also, the composition of meals in a short time before a dive has a great importance to the health and safety of a diver. Diuretic drinks that rise diuresis can lead to dehydration, and excessively large meals can cause gastroesophageal reflux under the influence of pressure while diving. Consequently, physicians, that are into the pathophysiology of diving stress aspects, highlight the validity of proper nutrition, which not only affects the well-being, but also the health and safety of diving [3].

The problem of long-term consequences in diving, which also has a significant impact on divers' diet, are still underestimated, but noticed more often by researchers. Numerous experimental - environmental and catamnestic, studies are conducted

worldwide and they have shown that professional and advanced training divers have had higher morbidity to the certain types of cancer, developed arteriosclerotic processes and general biomorphosis more quickly. It is understood that it is mainly connected with increasing quantities of free radicals formed during the hyperbaric exposure and impaired antioxidant barrier. During the tests that were carried out by the Department of Biochemistry at Medical University of Bydgoszcz, in cooperation with the Department of Maritime and Tropical Medicine and Military Medical Institute in Gdynia, the sign release and activity of oxidative stress markers in blood were made to subjects hiperbarically exposed. It was found that there is a strong reduction in antioxidant defense barrier, and in connection with it the severity of oxidative stress [4]. It is a tip for nutritionists, for the choice of diet for divers, since the frequent severity of oxidative stress involves rapid aging of the organism, and increased morbidity of cancer. Proper diet rich in vitamins A, E, C, and components that grate free radicals: free radicals scavengers is important to increas protection of the organism of a diver. In this case, the use of proper diet may reduce the adverse impact.

DIVER`S DIET

Having the health risks and individual circumstances in mind, we can create a plausible model of the diver's best feeding. During the higher activity connected with diving the diver should certainly eat more energetic meals. However, we should not forget about the risks arising from poorly composed diet and distributions of major nutrients. General principles of rational nutrition are simple and easy to use, provided that meals are varied and moderate. The basic principle is to maintain the appropriate balance between the main nutrients: protein - component of building block - for adults it should be about 12-15% of the daily food ration (1 g protein is 4 kcal of energy), fat (both saturated and unsaturated) - the energy component of long-term metabolism - 25-30% of the daily food ration (1 g fat is 9 kcal of energy), carbohydrates - the main ingredient in energy - 55-60% of the daily food ration (1 g of carbohydrate is 4 kcal of energy). Carbohydrates should be dominant components of everyday diet. Their main sources are cereals, potatoes, vegetables and fruits. Vegetable products are extremely important also because of the fiber content, which governs the intestine and does not appear in any other products and is a necessary component, though it is not assimilated by the human body. Raw vegetables and fruits are an irreplaceable source of vitamins, though the characteristics of individuals are extremely important determinants of the possibility of their consumption. Each diver should know his body capacity and absorbing of the products of plant and does not ignore them. If anyone finds flatulence after any product, at a time he or she should definitely avoid diving. Divers should not be forced to eat the products considered to be generally healthy, if they have discomfort after such a meal. Due to protection reasons, divers should only consume the increased dose of the antioxidant vitamins A, E, C and beta-carotene, glutathione, glikozynolans and bioflavonoids. The large quantities of the compounds found in fruits and vegetables with a red tint, the cabbage family vegetables, citrus fruits, nuts, almonds, sunflower pips, pickled cabbage, potatoes. It is good to note that vitamins A and E are fat soluble, so that the organism requires additional fat, preferably vegetable one, to assimilate them. Fresh fruits and vegetables also contain fruit acids, which strongly accelerate fat metabolism, and some such as pineapple, an lipolid enzyme directly hydrolyzing fats. Therefore, fruits and vegetables should be eaten mostly during each meal.

Fats are also an important source of energy, but also they are a risk factor that should come from fish, plants (vegetable fat), meat and dairy products. Diver during

the increasing diving activity should definitely avoid too much fat in the diet. He should eat meat with a minimum of fat, and dairy products with reduced fat, up to 2%. It is untrue belief that margarine have less fat than butter, the difference is small and the type of saturated fatty acids may play a role. However, fats also play an important role in nutrition and can not be completely eliminated, they just should be limited. What is important is the choice of fats in the diet, it is best if the polyunsaturated fatty acids necessary for life, that we can find in fish and vegetable oils, dominate.

Proteins are the main component of the building block of the body, so a fully formed adult human body does not require them in large quantities, it is only necessary in cell renewal. The most important determinant of a protein is its amino acid composition. Proteins closest to the human body in terms of building block are those of animal origin, although proper vegetarian diet can also meet the needs of the body of essential amino acids. It is important that a diet should satisfy the full demands of the body with essential amino acids, which is very simple in balanced and varied diet.

Water is essential to live. Everyone, who runs out of it, knows that. Adequate hydration is extremely important matter for divers and should not be underestimated. There are several factors causing dehydration during diving. Large quantities of beverages non-carbonated, of course, and no diuretics (such as coffee and many energy drinks) are highly recommended both before diving, as well as afterwards. It is also recommended that beverages should be heavily sweetened to provide an additional portion of energy.

Thinking about the best distribution of meals during diving activity, it is recommended not to eat meal immediately before the dive. Ideally, the last meal should be two hours before the planned exposition. As far as the overall distribution of meals during the day is concerned, divers should take into account the capability of the body's metabolism so the food should not be rich, but moderate and frequent, up to 5 - 6 meals a day. This meal plan meets the increased energy needs of the organism and allow the diver to complete the metabolism of food intake without causing burden on the gastrointestinal tract.

FULL VALUE FOOD

To provide the body with all the necessary ingredients it is important to uphold the principle of diversity. Cereals should eat several times a day, preferably wholegrain ones. Fruits and vegetables should be added to every meal. They are indicated in the raw form, but cooked ones also can provide the body with many vitamins and fiber. For this course, dairy products, and it is not irrelevant whether it is fresh milk or yogurt because they include practically the same amounts of vitamins and microelements. The differences is observed only between dairy products such as yellow and cottage cheese. Additionally, of course, in moderation, preferably with a lean species, meat, sausages and eggs should be eaten. Fats also in moderate amounts, preferably of plant origin should be consumed.

It may often be considered if the body is able to supply all the necessary ingredients, because of the recommended daily intake, which may seem high and not feasible. The question arises whether take supplements in pill form or not. You should therefore consider how much and what to eat, to provide the body with all that is necessary for proper functioning. First of all, what is the demand? The recommended daily intake from 19 to 65 years is similar, but differs in gender. We will study here only the necessary components, that should be increased in diver's diet comparing to the normal daily intake, especially during increased activity of diving. A reference standard will be given and it will be the recommended daily intake of the significant differences separately for women and men [2].

Vitamin A	k-800 µg, m-1000 µg
Vitamin E	k-12 mg, m-15 mg
Vitamin C	100 mg (smoking person – 150 mg)
Calcium	1000 mg
Magnesium	k-300 mg, m-350 mg
Ferrum	k-15 mg, m-10 mg
Fibre	minimum 30 g

Table 1

Content of essential vitamins and trace elements in most food products.

product (100 g)	vit.A (µg)	vit.E (mg)	vit.C (mg)	calcium (mg)	magnesium (mg)	ferrum (mg)	fibre (g)	energy (kcal)
apple (200 g)	12	1	24	14	12	1	4	108
orange (200 g)	6	0,6	100	84	28	0,8	3,2	84
banana (200 g)	10	0,6	22	16	62	0,6	3,6	176
peach	15	1	10	8	9	0,5	1,9	42
lettuce	73	0,6	15	19	5	0,4	0,6	13
cucumber	65	0,1	8	15	8	0,2	0,5	12
paprika	180	2,5	120	10	12	0,4	3,6	19
tomato	114	0,8	25	9	14	0,3	1	17
chive	50	0	47	129	44	1,9	0	27
carrot	1700	0,5	7	41	17	0,4	3,6	25
milk/joghurt 1,5 %	13	0	2	123	12	0,1	0	47
small roll	0	0	0	27	30	1,2	3	274
Wholewheat rye bread	80	1,2	0	37	54	2	8,1	195
cooked potatoes	0	0	14	10	0	0,8	1,7	70
beef	20	0,5	0	4	21	2,2	0	105
pork	0	0,6	2	5	17	2,2	0	191
smoked ham	4	0,3	0	2	24	1,1	0	152
egg	117	1	0	23	5	0,9	0	67
butter (10 g)	65,3	0,22	0	1,3	0,3	0	0	75,4
dark chocolate	0	2	0	60	100	3	15	479
	2524,3	13,52	396	637,3	474,3	20	49,8	2178,4

This is not an example of the daily menu, but often consumed products - Tab. 1st. As you can see not only is it easy to provide the body with the daily dose of nutrients, but also it is easy to exceed it. The simple conclusion is that supplementation is unnecessary and may even be dangerous to our health. The deficiency of vitamins and trace elements is easy to make, but the excess is much more difficult to remove from the body, e.g. hypervitaminosis. The basis for rational nutrition is the variety of products that are consumed, and it should form the basis of any diet.

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