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Age And Sex Characteristics Of Thyroxine And Triiodothyronine Content In The Blood Of White Rats With Experimental Alimentary Obesity Under The Influence Of Iodine.

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ABSTRACT

Thyroid hormones play an important role in the metabolism of lipids. Obesity is a negative show of hypothyroidism, which leads to a decrease in thyroxine and triiodothyronine. The aim of the research was to study the age and sexual characteristics of the T3 and T4 content in the blood of white rats with experimental nutritional obesity under the influence of iodine. Experimental alimentary obesity was modeled on 92 male and female white rats of the Vistar line of all ages. Within 45 days, the corresponding groups received biodegradable iodine in the form of "Jodis-concentrate" and inorganic iodine in the form of potassium iodide as part of medication "Jodomarin". The statistical processing of the obtained research results was processed using the software "Excel" ("Microsoft", Office). The article presents the results of experimental studies, in which age and sexual characteristics of the negative influence of experimental alimentary obesity on the content of T3 and T4 in blood serum of white rats are established. Positive corrective effect of Jodis-concentrate and Jodomarin upon their intragastric administration to 1,5-, 2,5- and 5-months males and females of white rats for 45 days on the content of triiodothyronine and thyroxine in serum of their blood, which is more performed due to the effect biodegradable iodine in the Jodis-concentrate than the effect of inorganic iodine as part of Jodomarin.

Keywords: obesity, white rats, age, sex, thyroxine, triiodothyronine, Jodis-concentrate, Jodomarin.

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INTRODUCTION

For decades, it has been recognized that thyroxine (T4) and triiodothyronine (T3) control the processes of growth and development of the body, affecting the metabolic homeostasis of cells [5, 12, 17, 18]. Lack of thyroid hormones leads to hypothyroidism, in which there is a slowing down of all metabolic processes, which leads to increase body weight [1]. The most common and negative manifestation of hypothyroidism of the thyroid gland is obesity, between which there is a pathogenetic relationship [3, 16]. At the same time, there is an increase in energy expenditure and lipid imbalance [1, 9, 13].

With hypothyroidism, low levels of T4 in the blood are observed [2, 8, 15]. Along with this there is a compensatory increase in T3 level, since triiodothyronine may for some time be below normal, as the transformation of T4 to T3 increases. It is known that triiodothyronine is an active thyroid hormone, about 80% of which is formed from thyroxine (liver and kidney), and only 20% is secreted directly by the thyroid gland [2, 14]. In addition, in some studies of hypothyroidism has been shown a decrease in both thyroxine and triiodothyronine [8, 15].

Many scientists have been studying the age and sex changes in the content of T3 and T4, but there are no clear conclusions. According to some scientists, there are slight age variations in the content of thyroid hormones. Thus, the level of thyroxine and triiodothyronine in rats at the age of 5 weeks was 63,700 nmol/l and 1,850 nmol/l, respectively. For healthy people, the concentration of triiodothyronine ranges from 1.17 to 2.18 nmol / l, and thyroxine is 62-141 nmol/l. In sexually mature rats, thyroxine content is much higher than in humans and is within the range of 58.3-62.5 nmol / l, and triiodothyronine is 2.45-1.05 nmol/l. The level of thyroid hormones in the blood of older people and old rats is almost unchanged, although with age there is a decrease in their secretion [6]. There is evidence that older people have T3 level at 10-15% lower than younger ones. This is due to a decrease of the decay rate of T4 in T3. In addition, the reasons for the decrease T3 level may be due to a number of diseases, the regular adoption of drugs [2].

Concerning the sexual characteristics of hormone levels in the blood, according to the research of scientists, the T4 content was higher in male rats than in females, and T3 was lower in females at the age of 17 and 30 weeks, and then there was an increase and sustainability of indices, and there was a higher level than of males. It has been found that in rats of both sexes it was age-related decrease of T4. Another study showed that T3 levels in the blood decreased in males, and females had no significant differences throughout their lives [19]. According to other researchers who studied hormones in hypothyroidism, T3, T4 were lower in women than in men. After 40 years, women observed a decrease in their production [10]. Thus, unambiguous reliable data on the production of hormones by thyroid gland at different stages of ontogenesis, especially due to aging and obesity are absent. Some scientists described the decrease of thyroxine levels in blood serum of female rats, while others reported low levels of T4 and T3 in older males [4]. It is known that the intensity of synthesis of thyroid hormones and the maintenance of their proper level in the blood correlates directly with the intake of alimentary iodine in the body.

The aim of our research was to study the age and sex characteristics of the content of thyroxine and triiodothyronine in serum of white rats with experimental alimentary obesity (EAO) under the influence of biologically active iodine in the composition of "Jodis-concentrate" (J-C) and inorganic iodine (KJ) as part of "Jodomarin" (JM).

MATERIALS AND METHODS

The research was conducted on 92 males and females of white rats of the Vistar line of all ages. They were in the appropriate sanitary-hygienic conditions of the vivarium of SHEE I. Horbachevsky Ternopil State Medical University of the Ministry of Health of Ukraine.

Both, males and females, were divided into 3 age groups of 16 animals in each: 1st group - 1.5 month-old; 2nd - 2.5 month-old; 3rd - 5th month-old. In each age group there were 4 subgroups of 4 animals in each: 1 - control, which was on the main diet at vivarium; The 2nd, 3rd and 4th subgroups with experimental alimentary obesity, which were formed through an inductor of a food traction - a sodium glutamic acid salt in the ratio of 0.6: 100.0 and a high calorie diet that included standard food (47%), sweet concentrated milk (44%), corn oil (8%) and vegetable starch (1%) [11]. Daily during 45 days, animals of the 3rd group received intragastrically

intravenous iodine in the form of "Jodis-concentrate" in a dose of 0.1 ml (0.4 micrograms of iodine) per kg of body weight per day and in 4th group - inorganic iodine in the form of potassium iodide in the preparation "Jodamarin" at a rate of 0.4 micrograms of potassium iodide per kg of body weight of an animal a day.

During 45 days of an experiment, it was control of reproduction of alimentary obesity by weighing animals, measuring nasal-anal length and calculating the body mass index (BMI) - dividing the body weight in grams by the length in square centimeters.

At the end of the experiment, the animals were killed by decapitation under thiopental anesthesia. During the experiment, the requirements of the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasbourg, 1986), the Law of Ukraine On the Protection of Animals from Cruelty and the EU directive 2010/10/63 on the protection of animals used for scientific purposes were kept.

Blood was taken from the cavity of the heart into the test tubes and centrifuged to obtain blood serum, in which the content of free T3 and T4 was determined using a set of reagents (CJSC Vector-Best, Russia).

Statistical studying of the obtained research results was processed using the software "Excel" ("Microsoft", USA) Statistica V.10.1. (Statsoft, USA), by method of variation statistics using the Mann-Whitney U-test and Student's test, statistically significant changes were considered for $p < 0,05$.

RESEARCH FINDINGS AND DISCUSSION

As a result of the conducted research data (Table 1-3) characterized age and sexual characteristics of thyroid hormones level in blood serum of white rats on the background of experimental alimentary obesity, were obtained. Thus, according to Table 1-3, the content of triiodothyronine and thyroxine in the blood serum of clinically healthy white rats in the control group at different ages and conditions did not differ significantly, however, their highest content was set at the age of 6,5 month-old animals in males and females. There are our research findings of 3 month-old males and females of white rats in Table 1.

Table 1. The content of thyroid hormones in serum of 3 month-old males and females of white rats, $M \pm m$, $n = 4$.

Indexes	Subgroups			
	1	2	3	4
	Control group	experimental alimentary obesity	experimental alimentary obesity + Jodis-concentrate	experimental alimentary obesity + Jodamarin
Males				
T3, pmol/l	5,31±0,36	4,03±0,23*	5,17±0,43#	5,09±0,47
T4, pmol/l	15,11±0,72	13,29±0,51*	14,93±0,71#	14,73±0,6
Females				
T3, pmol/l	5,18±0,25	4,19±0,33	4,98±0,32#	5,04±0,36#
T4, pmol/l	14,83±0,60	13,11±0,72*	14,75±0,61#	14,61±0,70#

Note: here and in the following tables * - are reliable relative to the indicators of animals of the first subgroup ($p < 0,05$); # is reliably relative to the indicators of animals of the second subgroup ($p < 0,05$).

In serum of males 3 month-old white rats, the 2nd subgroup of EAO had a significantly lower content of triiodothyronine and thyroxin, about 24% and 12% respectively, and in females of this age about 19% and 12%, respectively, comparing to control animals, as shown in Table 1. The content of triiodothyronine and thyroxin in serum of 3 month-old males of white rats with EAO and intragastric administration of iodide-

concertate was significantly higher by 22% and 11%, while in females it was significantly higher by 16% and 11%, for animals of the 2nd group with EAO. The obtained data confirm positive corrective effects of “Jodis-concertate” on the content of triiodothyronine and thyroxine in serum of white rats, which is found in increasing regardless of sex. In animals of the 4th group with EAO, who received intragastrically “Jodomarin”, the content of triiodothyronine and thyroxine in their blood serum was 21% and 10% significantly higher in males and respectively 17% and 10% in female white rats compared to animals of the 2nd group with EAO. This also confirms positive effect of the alimentary introduction of “Jodomarin” on the content of triiodothyronine and thyroxine, which is manifested in significant increase in the blood serum of 3 month-old white rats.

The content of triiodothyronine in the serum of 4 month-old male white rats of the 2nd subgroup with EAO did not change significantly, and the thyroxine content was significantly lower by 12%, and in females of this age the content of triiodothyronine and thyroxine, respectively, 25% and 13%, compared with control group of animals, as it is shown in Table 2.

Table 2. Content of thyroid hormones in blood serum of 4 month-old males and females of white rats, M ± m, n = 4.

Indexes	Subgroup			
	1	2	3	4
	Control group	experimental alimentary obesity	experimental alimentary obesity + Jodis-concentrate	experimental alimentary obesity + Jodomarin
Males				
T3, pmol/l	5,72±0,45	4,84±0,40	5,83±0,37	5,68±0,40
T4, pmol/l	14,51±0,86	12,38±0,71*	13,75±0,65	13,66±0,86
Females				
T3, pmol/l	5,73±0,44	4,28±0,43*	5,53±0,47 [#]	5,41±0,42 [#]
T4, pmol/l	13,77±0,66	12,01±0,68*	13,89±0,75 [#]	13,52±0,63 [#]

The content of triiodothyronine and thyroxine in the blood serum of 4 month-old male white rats of the 3rd and 4th subgroups with EAO, which were intragastrically administered, respectively, of “Jodis-concertate” and “Jodomarin” were not significantly different from animals of the 2nd subgroup with EAO.

In the serum of 4 month-old female white rats of the 3rd subgroup with EAO, levels of triiodothyronine and thyroxine were significantly higher by 23% and 14%, respectively, and in the blood serum of female rats of white rats of the 4th subgroup with EAO were significantly higher, respectively, at 21 % and 11%, due to the 2nd subgroup with EAO. The obtained results indicate a slight effect of EAO and intragastric administration of “J-C” and “JM” on the content of triiodothyronine and thyroxine in the serum of 4 month-old male white rats and about the true effect on females of the same age.

Research results of the third age group are provided in Table 3.

Table 3. Content of thyroid hormones in blood serum of 6.5 month-old males and females of white rats, M ± m, n = 4.

Indexes	Subgroups			
	1	2	3	4
	Control group	experimental alimentary obesity	experimental alimentary obesity + Jodis-concentrate	experimental alimentary obesity + Jodamarin
Males				
T3, pmol/l	5,65±0,45	4,27±0,37*	5,60±0,43 [#]	5,48±0,48 [#]
T4, pmol/l	14,53±0,95	12,12±0,73*	14,29±0,82 [#]	14,31±0,9 [#]
Females				
T3 pmol/l	5,52±0,41	4,18±0,39*	5,47±0,31 [#]	5,39±0,37 [#]
T4 pmol/l	14,42±0,83	12,23±0,64*	14,34±0,86 [#]	14,23±0,75 [#]

Table 3 shows that the content of triiodothyronine and thyroxine in the blood serum of 6.5 month-old male white rats of 2nd subgroup with EAO was by 24% and 16%, respectively, and females by 24% and 13%, lower comparing with the animals of the 1st control subgroup. The obtained results indicate the negative effect of experimental obesity on the content of thyroid hormones in serum of both females and males of white rats. Intra-gastric administration of “Jodis-concentrate” to males of the 3rd subgroup with EAO resulted in a significant increase of triiodothyronine and thyroxine in their serum of blood by 24% and 13%, and in females by 23% and 13%, respectively, comparing with animals of 2nd subgroup with EAO. Administration of “Jodamarin” to males of the 4th subgroup led to a significant increase in the content of triiodothyronine and thyroxine in serum of their blood, respectively by 22% and 15%, and in females, respectively by 21% and 131%, comparing with animals of 2nd subgroup with EAO. These results indicate a single-way positive effect of “Jodis-concentrate” and “Jodamarine” on triiodothyronine and thyroxine in the serum of 6.5 month-old white rats of both sexes, but to a greater extent this effect is expressed in males.

Studied endocrine disorders in changing the content of thyroid hormones in white rats against the background of experimental alimentary obesity are confirmed by other scientists who indicate that thyroid dysfunction may be both, a cause and a consequence of obesity [7]. However, the results of the presented experimental studies, to some extent, indicate on the development of manifested hypothyroidism [13] in white rats with alimentary obesity, which is confirmed by a decrease of triiodothyronine and thyroxine in both females and males of all age groups.

CONCLUSIONS

Thus, as a result of the experimental studies, age and sex characteristics of negative influence of experimental alimentary obesity on triiodothyronine and thyroxine in the blood serum of white rats were obtained, which is confirmed by studies of other scientists [3, 20]. However, a positive corrective effect of “Jodis-concentrate” and “Jodamarine” of intra-gastric administration to the 1,5-, 2,5-, and 5 month-old males and females of white rats during 45 days on the content of triiodothyronine and thyroxine in serum of their blood was found and generally shown through the influence of biologically active iodine in “Jodis-concentrate”, than the effect of inorganic iodine in “Jodamarine”.

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