MEDICAL SCIENCES

HOMOCYSTEINE AND REGULATION OF THYROID HORMONE METABOLISM IN CHILDREN LIVING NEAR THE CHERNOBYL EXCLUSION ZONE

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The implementation of social and medical projects of the European Commission and the Regional Council of Rhone-Alpes (France) in Ukraine in 2014-2017 contributed to monitoring related to the assessment of the thyroid gland (TG) condition among children living near the Chernobyl Exclusion Zone (ChEZ), in the territory whose soils are contaminated with radioactive elements.

During the studies, structural changes in the TG were detected in 5.6% of cases, and thyroid hormone metabolism disorders were registered in 35.5% of cases [1, p. 7]. Moreover, in the blood of more than 70% of the examined children of the Ivankovsky district of the Kyiv region, an elevated level of the sulfur-containing amino acid homocysteine (Hcy) [2, p. 29] was recorded – a participant in the most important metabolic processes in the body.

The occurrence of hyperhomocysteinemia in the examined children is associated with forest fires in the ChEZ [3, p. 28].

The study established that after forest fires in the ChEZ, the concentration of Hcy in the blood of children, both in the general group and in individual genetic subgroups, significantly increased [3, p. 25].

The proportion of cases of individual increase in the level of Hcy in the blood, both in the general group of children and in individual genetic subgroups, was more than 70% [3, p. 26].

Considering the high level of ^{137}Cs and ^{90}Sr in the soil and forest trees of the ChEZ [3, p. 9, 13], it is possible, with a high degree of probability, to assert the negative impact of these long-lived radionuclides on the metabolism of sulfur-containing amino acids in the bodies of children living near the ChEZ.

Literary sources indicate an increase in the level of H_{cy} in the blood with hypothyroidism [1, p. 16].

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In this regard, to clarify the relationship between hyperhomocysteinemia and pathological processes in the TG, it is logical to assess the interaction of H_{cy} and thyroid hormones.

In the course of laboratory-genetic, statistical and analytical studies conducted by us in 2014–2025, the participation of H_{cy} and the folate cycle (FC) in the processes of hormone metabolism of the pituitary-thyroid axis was established.

An illustration of this is the direct correlation between Hcy and the thyroid-stimulating hormone of the pituitary gland (TSH).

This correlation was recorded if the number of cases of hyperhomocysteinemia in the analyzed group exceeded the 70% threshold.

In addition to environmental influences, genetic polymorphisms of FC contributed to the increase in the concentration of H_{cy} in the blood and, in this regard, the activation of TSH synthesis.

The most pronounced direct correlation of H_{cy}-TSH was recorded in subgroups including cases of combination of FC genotypes with risk alleles (Table 1).

Table 1

Correlation relationship of H_{cy}-TSH in subgroups of children of Ivankovsky district with a combination of FC genotypes.

Combination of genotypes	Correlation coefficient	H_{cy}-TSH	N
A/G, G/GMTR:2756 – A/G, G/G MTRR:66	Spearman's	+ 0.355**	77.6%
	Sign. (2-tailed), p	0.006	
	n	58	
A/G, G/GMTR:2756 - C/T, T/TMTHFR:677	Spearman's	+ 0.579**	78.4%
	Sign. (2-tailed), p	0.0001	
	n	37	
A/GMTR:2756 - A/CMTHFR:1298 - C/TMTHFR:677 - A/G, G/GMTRR:66	Spearman's	+ 0.736**	84.6%
	Sign. (2-tailed), p	0.004	
	n	13	
A/G, G/GMTR:2756 - A/CMTHFR:1298 - C/TMTHFR:677 - A/G, G/G MTRR:66	Spearman's	+ 0.768**	80.0%
	Sign. (2-tailed), p	0.001	
	n	15	

*Note. ** – correlation is significant at the 0.01 level (2-tailed); N – the proportion of cases of hyperhomocysteinemia.*

The state of hyperhomocysteinemia contributed not only to the activation of TSH synthesis, but also affected the process of thyroxine (T_4) deiodination and the formation of triiodothyronine (T_3) in peripheral tissues [4, p. 36].

At the same time, H_{cy} was utilized in the cycle of transsulfuration reactions, with the formation of cysteine.

Cysteine in combination with selenium is a coenzyme of deiodinase, an enzyme that catalyzes the process of T_4 deiodination and the formation of T_3.

T_3 has the ability to stimulate the activity of FC enzymes, in particular, methylenetetrahydrofolate reductase, and the formation of the active form of vitamin B_9 – 5-methyltetrahydrofolate (5-MTHF) [5, p.41; 6, p. 16].

An illustration of this is the direct correlation between T_3 and B_9 in the subgroup of children with the A/G, G/GMTR:2756-A/CMTHFR: 1298-C/TMTHFR:677- A/G, G/G MTRR:66 genotype combination (Table 2).

Table 2

Correlations in a subgroup of children with a combination of genotypes A/G, G/GMTR:2756- A/CMTHFR:1298 - C/T MTHFR:677 - A/G, G/GMTRR:66.

Correlation coefficient, significance p	Correlations	
	H_{cy} - TSH	**T_3 - B_9**
Spearman's	0.768**	0.649**
Sign. (2-tailed), p	0.001	0.009
n	15	15

*Note. ** - correlation is significant at the 0.01 level (2-tailed)*

5-MTHF with the help of B_{12}-methionine synthase participates in the formation of the active form of vitamin B_{12} and methylation of H_{cy}.

Thus, with the help of T_3, the methylation of H_{cy} is increased and its concentration in the blood decreases.

Hyperhomocysteinemia stimulates the metabolism of thyroid hormones, with the help of which the correction of energy ill-being associated with environmental influences and defects in the FC genes is carried out.

Based on this, Hcy is an element of the body's adaptation system to unfavorable living conditions.

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