MEDICAL SCIENCES

^{137}CS DECORPORATION AND SULFUR-CONTAINING AMINO ACID METABOLISM IN CHILDREN LIVING NEAR THE CHORNOBYL NUCLEAR POWER PLANT

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The European Commission project "Health and Ecological Programmes around the Chornobyl Exclusion Zone: Development, Training, and Coordination of Health-Related Projects", implemented in Ukraine from 2013 to 2017, established a direct correlation between the specific activity of ^{137}Cs in the body and serum aspartate aminotransferase (AST) activity in a group of children living near the Chornobyl Exclusion Zone (ChEZ) [1, p. 351].

Considering previous studies [2, p. 71], this confirms the negative impact of ^{137}Cs on myocardial mitochondria.

These children also showed elevated blood levels of the sulfur-containing amino acid homocysteine (H_{cy}), an intermediate metabolite in the metabolism of the essential amino acid methionine (Met) [1, p. 345], above the established physiological level.

Met, entering the body enterally, interacts, under the influence of methionine adenosyltransferase, with adenosine in the form of ATP, forming S-adenosylmethionine, the main donor of methyl groups in the body.

S-adenosylmethionine, donating methyl groups in protein and lipid methylation reactions, creatine synthesis, and neurotransmitter synthesis, is converted to S-adenosylhomocysteine and then to H_{cy}.

H_{cy} undergoes remethylation to form internal Met.

The remethylation process is carried out with the help of folate cycle (FC) enzymes and methyl group carriers.

The process of H_{cy} methylation and secondary Met formation depends on the activity of FC enzymes.

H_{cy} methylation also depends on betaine, a trimethylglycine formed in the mitochondria.

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Analytical studies have shown the involvement of H_{cy} in the formation of the active form of thyroid hormone, triiodothyronine (T_3), in peripheral tissues. T_3 stimulates the synthesis of the methyl group carrier, the active form of vitamin B_9, 5-methyltetrahydrofolate [3, p. 254].

T_3 stimulates cellular energetics and regulates Ca metabolism [4, p. 207].

H_{cy}, by interacting with serine, is involved in the formation of glutathione, a component of the antioxidant system.

This is an important role for H_{cy} in protecting the body from metabolic stress induced by radiation exposure [3, p. 251].

Cortisol, whose production is also stimulated by H_{cy}, also exerts an antioxidant effect [3, p. 253].

In the examined group of children, an inverse correlation was found between the specific activity of ^{137}Cs in the body and the level of Ca in the blood [1, p. 342].

At the same time, a direct correlation was recorded between H_{cy} and Ca [1, p. 346], indicating that H_{cy} influences Ca metabolism.

Under conditions of radiation exposure, when the bodies of children and adults constantly contain radioactive elements such as ^{137}Cs, the level of H_{cy} in the blood is elevated above the established physiological level.

The most pronounced increase in blood H_{cy} levels was recorded in the majority of children examined 6 months after the forest fires in the ChEZ [5, p. 24].

In children from settlements located near the ChEZ, immediately after a short (3-week) health trip to a European Union country, the specific activity of ^{137}Cs in the body decreased ($Z = -6.706$, $p = 0.0001$; $n = 67$), while the blood H_{cy} level increased – $Z = -4.520$, $p = 0.0001$, $n = 67$ (Table 1).

Table 1

Statistical characteristics of the ^{137}Cs and H_{cy} levels in the bodies of the examined children

Examination	^{137}Cs Bq/kg		H_{cy}, µmol/L	
	Me	IQR	Me	IQR
No. 1	2.780	2.350 – 3.450	9.900	8.600 – 11.680
No. 2	2.350	1.980 – 3.000	10.500	9.400 – 12.600

Note. No. 1 – examination before travel to the European Union country; No. 2 – examination after returning from the European Union country. Me – median; IQR – interquartile range.

The inverse correlation reflecting the relationship between these indicators is more pronounced after the return of children from a European Union country (Table 2).

Table 2

Results of correlation analysis in the group of children examined

The group of children examined	Correlation coefficient	^{137}Cs - H_{cy}	
		No. 1	**No. 2**
No cases with the T/T genotype of MTHFR:677	Spearman's	- 0.314*	- 0.358**
	Sign (2-tailed), p	0.012	0.004
	N	63	63

Note. No. 1 – examination before traveling to a European Union country; No. 2 – examination after returning from a European Union country.

The increase in H_{cy} formation may be due to increased Met intake by children during their vacation in a European Union country.

The elimination of ^{137}Cs radionuclides from the body is associated with energy processes in the cells of vital organs.

Met, as well as its metabolic product, H_{cy}, activate metabolic cycles that promote the restoration of cellular energy, resulting in the removal of ^{137}Cs and its decay product, ^{137}Ba, from cells into the extracellular space.

These results suggest the important role of the sulfur-containing amino acids Met and H_{cy} in the decorporation of ^{137}Cs radionuclides from children's bodies.

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