

COMPLEX RADIOBIOLOGICAL INVESTIGATIONS OF SMALL RODENTS FROM THE CHERNOBYL EXCLUSION ZONE

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Abstract

Radionuclide contamination of large areas caused by the Chernobyl disaster has set a number of important radioecological and radiobiological problems. One of the most important is the science-based forecast for the combined impacts of radiation factors on biota and human. Chernobyl exclusion zone (ChEZ) is a unique natural testing ground allowing research of the processes occurring in natural populations under the effects of ionizing radiation. Due to wide dissemination, close contact with the upper layers of contaminated soil and high reproduction rate, rodents are commonly used as bio-indicator species in radioecological and radiobiological research.

Purpose of this research - to investigate radiation-induced changes in the blood system of bank voles from the ChEZ using the complex of hematologic, cytogenetic and morphophysiological parameters.

Hematological study of quantitative parameters shown statistically significant difference in the total content of leukocytes and erythrocytes in the peripheral blood of animals from contaminated areas and reference group. It was manifested both in increasing and decreasing of average values comparatively reference levels in different years of observation. For example, number of bone marrow cells during 2012 and 2013 years increased by 40%, while in 2015 - decreased by 40%; the number of white blood cells and red blood cells was reduced throughout the period of study 20% and 70% in 2015, respectively.

Our study has shown that in the remote period after the Chernobyl accident elevated levels of genetic and cytotoxic damage in bone marrow of small rodents' generations from contaminated areas are still observed against the lability of the studied markers. It is shown that during years of observation frequency of binucleated and micronucleated karyocytes, apoptotic cells exceeded spontaneous levels in ~ 4; 3 and 2 times, respectively.

These changes are the result of the prolonged irradiation. It caused significant violations in processes of bone marrow cells' proliferation and differentiation. Up to 30% of the analyzed reticulocytes were micronucleated a lot. The tendency to decrease of their levels with time after the accident was marked. Increased levels of bone marrow cells with pathological features were accompanied by activation of their apoptotic elimination. It should be noted dose-response biological effects were not revealed.

Levels of ^{137}Cs and ^{90}Sr accumulation in the body of rodents from the ChEZ were estimated; their high lability during the time after the accident and inter-individual and were found. Radiation doses and structure of radiation loads on small rodents from contaminated sites are determined. During the years after the accident contribution of external and internal radiation in total absorbed dose were changed, indicating significant contribution of incorporated ^{90}Sr and ^{137}Cs .

Qualitative changes in hematopoiesis of animals from the ChEZ manifested in the disturbance of bone marrow cell maturation. Malfunction of hematopoiesis foci formation in liver and spleen was also found. Major changes were registered in erythroid lineage. High level of genotoxic and cytotoxic effects in bone marrow was observed.

Differences between the reference and the exposed groups were found by the study of morphological parameters of voles internal organs, confirming the activation of the physiological stress in the exposed animals.

The observed complex biological changes appear as the result of chronic combined exposure, complex compensatory and adaptive processes in natural populations of small rodents from the ChEZ.