ESTIMATION OF CYTOGENETIC AFTER-EFFECTS OF THE CHERNOBYL EXPLOSION IN BELARUS

N.A. Kartel, K.G.Yeliseeva, L.S.Mikhalevich,
R.I.Goncharova, E.N.Makeeva

Instituite of Genetics and Cytology, F.Skorina st.27,
220072 Minsk, Belarus; Tel/Fax: 375-172-39-49-17

INTRODUCTION

Investigation of mutation process in cells of human beings and animals from radiocontaminated areas of Belarus is a very important problem for understanding of Chernobyl accident consequences related with damages of genetic material in somatic and germ cells.

RESULTS AND DISCUSSION

Just after the Chernobyl accident we began cytogenetic studying of rodent, amphibian and children from radiocontaminated regions. Most of our investigations are carried out using a chromosome aberration analysis (metaphase and micronucleus methods) in different tissues: in mourine rodent - bone marrow cells, alveolar macrophages, intestinal epithelium; in frogs - bone marrow cells, intestinal epithelium; in children - peripheral blood lymphocytes. For slide preparation were used conventional methods (1-4). Berezinsky biosphere reserve, Minsk environs, Braslav District of Vitebsk Region were used as the control area. The data obtained in first years after the Chernobyl accident have shown a high level of cytogenetic damages in all objects examined: a) percentage of aberrant cells was much higher in cells of species from radiocontaminated areas than that in the control; b) aberration number in the damaged cells was higher in all objects from radiocontaminated areas. Multiple aberrations were found in cells of all the species studied; c) chromatide-type aberrations, chromosome type aberrations including markers of radiation (dicentrics and rings), were detected too.

A part of our investigations results in inhabitants of Gomel Region is presented in Table 1. Percentage of chromosome-type aberration is higher in peripheral blood lymphocytes of children than in bone marrow cells of animals because lymphocytes are out of cycle (Go) but bone marrow cells are proliferative, therefore during exposure they occur at different stages of the cell cycle. In view of this, aberrations of both chromosome and chromatide types arise naturally which corresponds to irradiation at stages G1 and G2. Increased level of cytogenetic damages in intestinal epithelium of frogs and rodent and in alveolar macrophages was found too.

For the last years a statistically significant reduction of the chromosome aberration frequency in bone marrow cells and in peripheral blood micronuclei of frogs from some areas was observed. In some areas we could not see aberration of chromosome type.

The results of 10-year examination of children from Gomel, Mogilev and Brest regions of Belarus either in dynamics or in statics have shown the necessity of evaluation a complete spectrum of genetic damages in peripheral blood lymphocytes (3-5).

Table 1. Level of chromosome aberrations in different objects from radiocontaminated regions of Belarus

Object of investigation, type of cells	Area	Density of contamination (kBq/m2)		Year	% aberrant cells in contaminated area / % aberrant cells in the control	Ratio chromosome and chromatide type of aberrations
		^{137}Cs	^{90}Sr			
Human (Children, peripheral blood lymphocytes)	v.Nudichi	680	118	1986	3.2	1.9 : 1
	v.Ilichi	815	127	1986	2.6	2.1 : 1
	v.Gluhovichi	490	67	1986	3.7	2.4 : 1
Bank vole (Cl.glareolus), bone marrow cells	v.Maisk	90	70	1986	4.5	1 : 2
				1991	4.5	1 : 10
	v.Babchin	1524	70	1986	3.3	1 : 25
				1991	4.0	1 : 7
	v.Lomachi	2331	284	1990-1993	4.4	1 : 2
Rana arvalis, bone marrow cells	v.Savichi	740	55	1986-1989	5.4	1 : 1.3
				1992	3.5	1 : 7,5
	v.Babchin	1110	77	1986-1989	4.6	1 : 5.5
				1990-1992	3.7	1 : 3
				1995	4.1	0 : 1
	v.Lomachi	2331	284	1986-1989	4.2	1 : 2.5
				1995	2.6	0 : 1

Biodosimetry carried out on the basis of our findings by using different standard curves (6-8) for evaluation of the absorbed dose has shown that the registered level of chromosome aberrations in children from the 30-km zone of Bragin District and the town of Bragin corresponds to the dose of 300-500 mSv.

A high level of mutant cells in HPRT locus ($1.4\text{-}2.9 \cdot 10^{-4}$ in comparison with the Minsk control group $3.5 \cdot 10^{-5}$ in 1991 and $3.0 \cdot 10^{-5}$ in 1993-1995) against the background of a relatively low level of chromosome aberrations as compared to 1986-1990 was revealed. However, quantitative values of chromosome aberrations exceeded appropriate frequences in the control groups and depended on the factors of the radioecological situation as well as on duration of residence in radiocontaminated region (9).

The role of cell death in forming the genetic effect of chronic irradiation of lymphocyte populations in peripheral blood of the examined children was revealed.

Complex interactions between mutation pressure and the selection effect of eliminating cells bearing chromosome aberrations and gene mutations take place in lymphocyte populations of children in radiocontaminated areas under chronic ionizing radiation. The cells with gene mutations compatible with their vital functions seem to be less subjected to the selection effect in minus-direction. Owing to this fact over the past years we observe a high level of cells with gene mutations against a background of a relatively low level of chromosome aberrations (in comparison with the level registered in the first years after the Chernobyl catastrophe).

Investigations demonstrate that chronic influence of the radiocontamination factors induces genome destabilization, increases genetic load at the level of somatic cell populations that results in reduction of their viability.

The increased radiosensitivity of a genetic apparatus of cultivated cells in children from contaminated areas was revealed (10). A chromosome aberration yield under additional X-irradiation of lymphocytes in children from radiocontaminated regions at the dose of 0.3 Gy is the same as the control children at the dose of 1.0 Gy. So far as there is relations between mutation emergence and carcinogenesis risk, the revealed children's populations with high genetic radiosensitivity should be classified as a risk group with high predisposition to tumoral diseases.

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