THE DICENTRIC ELIMINATION IN LYMPHOCYTES OF PATIENTS EXPOSED IN THE TIME OF CHERNOBYL ACCIDENT

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INTRODUCTION

The chromosome studies of atomic bomb survivors in Hiroshima and Nagasaki in some decades after the irradiation demonstrate a primary elimination of cells carrying unstable-type chromosome aberrations (dicentrics, rings, fragments). Its are met in less than 10% of all aberrant cells. A frequency of stable-type chromosome aberrations is remained almost unchanged in time in blood lymphocyte cultures of exposed persons (1). Therefore the stable-type chromosome aberrations are considered the most effective indicator of radiation dose in this time. However in first some years after exposure a level of dicentrics (a principal kind of chromosome aberrations for biological dosimetry in a near time after an irradiation) may be sufficiently high although over the first 4 years the decrease of the dicentric frequency at a rate of about 43% per year was observed (2). The number is a result of a cytogenetical investigation of a group of patients treated with X-rays for ankylosing spondylitis. Until recently the similar works with a use of therapeutic partial prolonged fractionated irradiation were a principal source of a data for study of the elimination chromosome aberration regularities. The initial (immediatly after an irradiation) and several repeated cytogenetic analysises after acute external total uniform or non-uniform exposures were carried out more or less in detail mainly for a small number of persons irradiated accidently (3-8). Unfortunately large numbers of persons irradiated different doses appeared after two radiation catastrophes of 1986-1987 years (Chernobyl and Goiania accidents). In this paper the results of reported counts of radiation-induced dicentrics for Chernobyl patients are presented. Its are important for an investigation of possibilites of biological retrospectival dose estimations.

MATERIALS AND METHODS

The initial chromosome aberration analyses of lymphocyte cultures from peripheral blood and bone marrow were made for a large number of exposed people during the nearest 1.5 days - 7 weeks after Chernobyl accident. The cytogenetical dose estimations were produced for 192 patients in the range from 0 Gy (dicentris were not found in lymphocyte cultures from 48 patients) to 13.7 Gy. Relatively uniform affection of a body (hemopoietic tissue) with the exception of a skin could be anticipated on the basis of a conformation of dicentric distributions to a Poisson distribution in lymphocyte cultures from the most of these patients who had been exposed at doses that were critical for the develepment of the bone marrow syndrome. Repeated cytogenetical examinations were made for the study of elimination chromosome aberration regularities. The peripheral blood lymphocyte cultures were incubated during 50 or 67 hours. The chromosome aberration counts were made in the first in vitro metaphase cells determined by fluorescense plus Giemsa staining.

108 lymphocyte cultures from 61 patients were investigated in the general time range from 3 to 30 months after accident. The number of repeatedly analysed lymphocyte cultures (in different times) for individual patients fluctuated from 1 to 4. The analysed cell numbers in several cultures varied from 15-41 cells (4 cultures) and 50-98 (9 cultures) to 100-200 cells (95 cultures).

RESULTS AND DISCUSSION

All patients were divided in development from initially estimated doses at 3 groups: exposed in doses 0.4-1.9 Gy (21 patiants, 34 repeated cultures), 2.1-3.7 Gy (26 patients, 48 repeated cultures) and 3.9-8.7 Gy (14 patients, 26 repeated cultures). After the termination of cytogenetical counts the percents of cells with dicentrics, average frequences of dicentrics and dicentric frequences in cells with dicentrics were selected for a sequent examination. The relationships (exponentional model) between percents from initial levels for repeated observed values of these cytogenetical indicies and the time after irradiation (in mounths) were received. The corresponding coefficients of the equations are presented in Table.

In general, our data evidently demonstrate the faster rates of decrease of average frequences of dicentrics and percents of cells with dicentrics in time after greater ininial doses than smaller initial doses. Also, dicentric frequencies in cells with dicentrics decreased in time slower than average frequencies of dicentrics. This fact and the reproduction of non-aberrant cells have to result in an apearance of the overdispertion of dicentric distributions by cells with respect to Poisson distribution. Apparently, the cells carrying the greater quantity of dicentrics relatively more rarely divide in vivo than cells with smaller quantity of dicentrics, although in general all cells divide some time or other. The dicentric frequency in cells carrying dicentrics made 1.00-1.25 in group of 0.9-1.4 Gy (that was greater 1.20 in 1 culture), 1,08-1,59 in group of 2.1-3.7 Gy (that was smaller 1.20 in 7 cultures and greater or equal 1.50 in 2 cultures) and 1.43-3.52 in group of 3.9-8.7 Gy (that was smaller 1.50 in 2 cultures).

The large individual variability was observed for rates and characteristics of decline of dicentric frequencies independently from initially valueted doses. Its could decline by degrees or by leaps. The long time periods of persistent yields of dicentrics could find out. Those were up to 19 mounths in the group 0.4-1.9 Gy, up to 11-12 mounths in the group of 2.1-3.7 Gy and up to 10 mounths in the group of 3.9-8.7 Gy. Sometimes the undulating changes of dicentric frequencies were observed 1 year after the accident (in general at the decreased levels in comparison with the initial yields).

Thus, essential difficulties and indefinities will appear in the time of the cytogenetical biological retrospectival dose estimations by dicentrics at the blood sampling delay of a few years.

CONCLUSIONS

1. The average rate of dicentric elimination was more after higher doses.
2. Dicentric frequencies in cells with dicentrics decreased in a development from time slower than average dicentric frequencies.
3. The essential individual variation was observed.

Table

The relationships between several cytogenetical indices (Y, % from initial values) and the time (t, months) after the irradiation at Chernobyl accident

Cytogenetical indices	Initial valuations of doses, Gy	Y = b•exp(a•t)		Coefficient of correlation	p
		a	b		
Avarage frequency of dicentrics per 100 cells	0.4–1.9	–0.049	93.7	–0.71	< 0.001
	2.1–3.7	–0.071	91.8	–0.85	< 0.001
	3.9–8.7	–0.112	97.5	–0.87	< 0.001
Percent of cells with dicentrics	0.4–1.9	–0.047	93.7	–0.72	< 0.001
	2.1–3.7	–0.069	94.6	–0.85	< 0.001
	3.9–8.7	–0.102	99.5	–0.88	< 0.001
Dicentric frequency in cells with dicentrics	0.4–1.9	–0.002	99.5	–0.27	< 0.1
	2.1–3.7	–0.004	97.5	–0.33	< 0.01
	3.9–8.7	–0.011	97.5	–0.50	< 0.01

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