

Individual Response to Low Dose Radiation Exposure as Determined by TCR Assay

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The aim of the work was to study the level of somatic gene mutagenesis in various human contingents exposed to ionizing radiation at doses up to 200 mSv. Flow cytometry was used to determine frequency of variant CD4+ T-lymphocytes with altered T-cell receptor (TCR) /CD3 expression as result of mutations at TCR locus. The TCR-mutant cell frequency was assessed in 250 unexposed control donors and 1198 exposed persons, including employees of Nuclear Power Engineering (mean dose (\pm SE) 100,0 \pm 6,6 MSv was accumulated within 27,4 \pm 1,1 years), cleanup workers of the Chernobyl accident (mean dose 100,0 \pm 9,1 MGy, analysis was performed 9-19 years after the irradiation) and persons living in radiation contaminated areas (¹³⁷Cs density 37- 555 kBq/m²) during 15-19 years. Results of group analysis demonstrated an increase in frequency of the TCR-mutant cells in NPE employees and the Chernobyl cleanup workers compared to that in age-matched control groups ($p < 0.05$, Mann-Whitney test). About 18 % of persons in both exposed groups had the TCR-mutant cell frequencies exceeding the 95% confidence interval that had been determined in control groups. Distribution of the mutant cell frequencies in other exposed persons corresponded to that in control group. The proportion of persons with elevated mutant cell frequencies was inversely proportional to age at exposure and did not depend on dose. Elevation of the mutant cell frequency significantly correlated with levels of intracellular NO and apoptosis of lymphocytes after additional irradiation in vitro. The frequency of the TCR-mutant cells in residents of radiation contaminated areas was significantly higher than in age-matched control groups ($p < 0.05$, Mann-Whitney test). Radiation effect depended on developmental stage at the moment of beginning of exposure. The most pronounced elevation of the TCR-mutant cell frequency was found in the individuals irradiated in utero. Only a proportion (12%) of persons exposed in postnatal period had the TCR-mutant cell frequencies exceeding the 95% confidence interval in the control group. The proportion of the persons with increased TCR-mutant cell frequencies was higher among residents of areas contaminated with ¹³⁷Cs density over 100 kBq/m² in comparison to less contaminated areas: 14,5% vs 8,8% accordingly ($p = 0,02$, Fisher's test). In conclusion, relatively small proportion of persons was found to react to low dose radiation exposure by elevation of the TCR-mutant cell frequency in all groups excluding irradiation in utero. The work was supported by Russian Foundation of Basic Research (# 08-04-00790).