Cytogenetic Adaptive Response and Genetic Instability Induced by Low-Dose Rate High-LET Radiation in Mice

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In the present work, we investigated the effect of a low-dose rate of high-energy radiation that simulates the radiation fields formed in the conditions of a high-altitude flight on mice in vivo. Adaptive response (AR) and genetic instability in generations F1, F2, F3 born from males irradiated under these conditions were examined by the micronucleus test in polychromatic erythrocytes of bone marrow. Two-month-old males of SHK mice were used. Irradiation was performed for 24h a day in the radiation field behind the concrete shield of the accelerator of 70 GeV protons (Serpukhov), which adequately simulates the component and spectral composition of the field formed in the atmosphere at a height of 10 km, to accumulate doses of 11.5, 21.5 and 31.5 cGy (1 cGy/day). For induction of AR, mice were exposed to irradiation according to the following scheme: an adapting doses of 11.5, 21.5, 31.5 cGy, followed after a day by a challenging dose of 1.5 Gy (28.2 Gy/h). To reveal the genetic instability, one group of males, descendants of chronically irradiated and unirradiated parents, at an age of two months were subjected to additional irradiation with a dose of 1.5 Gy from a 60Co source. Another group of males were exposed to chronic γ-irradiation by the scheme of AR: an adapting dose of 10 cGy (1 cGy/day) followed after a day by a challenging dose of 1.5 Gy. Bone marrow specimens for calculating micronuclei were prepared by the conventional method. The experiments demonstrated that: 1) irradiation of mice with all doses of high-LET radiation leads to an increase in cytogenetic damage in erythrocytes; 2) irradiation of mice with these doses induces no AR as opposite to γ-radiation; and 3) in mice of the F1 generation born from males irradiated with doses of 11.5, 21.5 and 31.5 cGy, an increase in sensitivity to additional irradiation with a dose of 1.5 Gy of γ-radiation and the absence of AR compared with the descendants of unirradiated males occur; 4) in mice of the F2 and F3 generations born from males irradiated with doses of 21.5 and 31.5 cGy, an increase in sensitivity to additional irradiation with a dose of 1.5 Gy of γ-radiation and the absence of AR take place too. The data obtained indicate the genetic instability in F1, F2 and F3 generations born from irradiated males. These findings may be used to assess the radiation risks from long-term high-altitude flights.

Article published by EDP Sciences and available at http://www.radioprotection.org or http://dx.doi.org/10.1051/radiopro:2008538