Effects of Chronic Low Dose-Rate Radiation Exposure on Blood System Cells of Mammals

A. Osipov

N.N. Semenov Institute of Chemical Physics RAS, Kosygin str. 4, 119991 Moscow, Russian Federation

andreyan.osipov@mail.ru

While there are no doubts about negative biological effects of high dose-rate ionizing radiation (IR), debates about whether low dose-rate IR exposure is harmful or beneficial (hormetic) are still continuing among scientific community. It is still not clear whether low dose-rate the IR induced effects are consequences of cells and organism adaptation to increase in IR background, and whether low doses cause any significant genetic alterations. The seven years results of molecular, cellular and cytogenetic studies of blood system cells of CBA male mice chronically (up to 1 year) exposed to gamma-radiation at a dose-rate range from 25 to 130 cGy/year are reviewed and summarized in this report. The analysis of the received experimental data allows propose the stage mechanism of the cellular response to chronic low dose-rate ionizing radiation exposure developing with an increase in the exposure time (dose) of irradiation. 1-st stage (doses up to 10-20 cGy) - accumulation of DNA damages (in particularly DNA-protein cross-links) in non-active chromatin, an increase in the cellular sensitivity to additional exposure (hydrogen peroxide); 2-ed stage (doses of 0.2-0.5 (0.6) Gy) - active response of cells to the damages and as consequence an increase in the quantity of DNA strand breaks, caused by activation of transcription and DNA repair, overproduction of the reactive oxygen species and apoptosis induction. Apoptotic elimination of highly damaged and radiosensitive cells from the cell population and antioxidant cell systems activation leads to increase of the cellular resistance to additional exposure (ionizing radiation, hydrogen peroxide). Balance between the DNA damages formation and their repair. And last (badly confirmed) 3-rd stage (doses upper of 0.5 (0.6) Gy) - additional formation of DNA damages by free radicals due to chromatin conformation changes and exhausting free radicals defense systems can leads to an increase in the cytogenetic disturbances frequency. Expression of these effects is strongly depends from the dose-rate of irradiation. During the presentation, the possible mechanisms of the observed low dose-rate radiation effects in mammals will be discussed with a separate emphasis on the role of non-targeted radiation effects in the formation of these effects.

Article published by EDP Sciences and available at http://www.radioprotection.org or http://dx.doi.org/10.1051/radiopro:2008742