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DNA DOUBLE-STRAND BREAK REPAIR IN RAT CEREBELLUM PURKINJE NEURONS AFTER PROTON AND 60CO γ-RAY EXPOSURE

The space environment is characterized by a wide spectrum of different radiation types ranging from energetic charged particles predominated by protons to γ-rays. The energetic charged particles are the most dangerous kind of radiation for crew of the ship in deep space. Heavy particles have to be considered an extremely dangerous radiation factor that can cause crew's operator activity disorders already during the flight. This approach is supported by results of the experiments in animals which were irradiated at charged particle accelerators at doses matching real fluxes of Galactic heavy nuclei during a flight to Mars. In the post-irradiation period, disorders of spatial orientation and cognitive functions were observed by different authors. To take into account the high biological effectiveness of high-energy heavy charged particles in inactivation of living cells it is important to study the molecular lesions in neurons of different brain structures of animals. It is especially important because the multiple DNA double-strand breaks (DSBs) are forms in genetic structures after heavy ion irradiation. We have studied the regularities of DNA DSB repair in rat cerebellum Purkinje neurons in vivo after exposure to 60Co γ-rays or protons (170 MeV). The evaluation of DNA DSB repair in Purkinje cells was performed by immunohistochemical staining of paraffin-embedded rat cerebellum tissue samples with the fluorescent antibody for the phosphorylated H2AX (γH2AX) histone and the repair protein 53BP1. The animals were irradiated in 1, 3, and 5 Gy of Co60 γ-rays. The kinetics of repair of the lesions was estimated after 3 Gy γ-ray and 1 Gy irradiation after 1, 4, 24 hours and 30 days. The analysis of colocalized radiation-induced γH2AX/53BP1 foci in Purkinje cell neurons after exposure to γ-rays or protons was done. The foci area with 1 Gy γ-ray or proton irradiation after 1 h was estimated. A linear dose dependence of radiation-induced colocalized γH2AX/53BP1 foci was observed. It has been established that most of the radiation-induced foci (RIF) are repaired during 24 hours post-irradiation (PI) for γ- and proton exposure. However, despite protons and γ-rays possess the same relative biological effectiveness of RIF induction, after a dose of 1 Gy the RIF area are statistically bigger for protons than the ones for γ-rays.

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