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DNA double-strand breaks comlexity in human fibroblasts under the action of low and high-LET radiation

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High-order clustered DNA lesions is the hallmark of the action of dense-ionizing radiation. It is defined as a combination of two or more individual lesions (single-strand and double-strand breaks (DSB), base damage, etc.) located within 1-2 DNA helical turns. Clustered DNA DSBs, which contains DSB and other DNA lesions, represent specific interest for investigation.
For investigation of induction and repair clustered DNA DSBs, human fibroblasts were irradiated with 60Co γ-rays (LET ≈ 0.3 keV/μm), 15N ions (LET = 181.4 keV/μm, E = 13 MeV/n) and protons in the expanded Bragg peak (LET = 2 –100 keV/μm, E = 0.01 –44 MeV/n). The dose for all types of radiation was 1.25 Gy. Key proteins that involved in the repair of base damage (OGG1) and DSB DNA (53BP1) were visualized by immunocytochemical staining and fluorescence microscopy. The quantitative analysis of 53BP1 and OGG1 foci that characterize the structure of clustered DNA lesions, were completed. The obtained results showed the high complexity of the structure of clustered DNA DSBs under the action of protons and 15N ions. The increase in the number of individual damage of different types in the cluster and the preservation of cluster's complex structure up to 24 hours under the action of charge particles were shown. The achieved results indicate that it is difficult to repair all types of damage included in the cluster compared to individual DNA lesions.

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