Ionizing Radiation Affects Epigenetic Programming in Adolescent Mice

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Humans are exposed to low and mild doses of radiation frequently, ranging from the natural environment to medical procedures like x-ray and CT scans. Ionizing radiation of various doses has been known to potentially cause not only cellular but also genomic changes. Here, we demonstrate that epigenetics is also altered by the radiation. Epigenetics is a chemical coding above the gene, which plays critical roles in brain development, cognitive aberrations and other neurological impairments. How radiation, as an external environmental factor, causes epigenetic change is not understood. DNA methylation, key in epigenetics, including 5-methylcytosine (5mC) and 5-hydroxymethylcytosine (5hmC) have been shown to either suppress or activate gene transcription. To aid in elucidating the role in which radiation affects epigenetic outcomes, we examined the effects of radiation on both epigenetic and phenotypic markers within the hippocampus. In this study we treated, via x-ray C57BL/6 mice, postnatal day (P) 21 with various doses (2Gy-4.5Gy) of radiation coupled with varying frequencies (0.5 Gy x 4, 1.5 Gy x 3, or 4.5Gy x 1) during a 4-week period. We used immunohistochemistry staining with cell proliferation, transcription and epigenetic markers. We found loss of 5mC in the sub-granular layer of the dentate gyrus (DG) in the upper and lower arms. Likewise a loss of 5hmC in the sub-granular layer of the DG, as well as in the cornu Ammonis (CA) layers 1 and 2. There was also loss of a transcriptional activation marker within the DG of the hippocampus. Furthermore, decreased cell proliferation in the adult neurogenesis in the hippocampus was found. Exposure to ionizing radiation altered the normal epigenetic profile of the mice. Understanding the mechanism by which ionizing radiation affects epigenetic programming will provide insight into how to develop protection against the potentially harmful risks associated with radiation exposure.

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