Ionizing Radiation Affects Epigenetic Programming in Young Adult 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 cause not only cellular and genomic changes, but specific neurological systems such as the limbic system have been indicated to be particularly vulnerable. Here, we demonstrated that epigenetics is also altered by radiation. Epigenetics is a subtle chemical coding above the gene, which plays a critical role in brain development, and downstream can cause the onset of cognitive aberrations and other neurological impairments. How radiation as an external environmental factor causes epigenetic changes is not clearly understood. DNA methylation, including 5-methylcytosine (5M) and 5-hydroxymethylcytosine (5-hmC) have been shown to either suppress or activate gene transcription and as such are key epigenetic players. To elucidate the role of radiation in epigenetic outcomes, we examined epigenetic, phenotypic and transcriptional markers via immunohistochemistry, in the hippocampus and cortex. In this study C57BL/6 mouse (postnatal day 21 (P21)) began a 4-week radiation treatment of various doses totaling (2Gy-4.5Gy) via global head targeting CT exposure. We found a loss of 5M and 5-hmC as well as transcriptional markers within regions of the hippocampus and cortex. There was a significant decrease in cell proliferation in the hippocampus- specifically, in the region responsible for adult neurogenesis. The cingulate cortex (a region adjacent to the hippocampus) also exhibited dramatic alterations in several epigenetic and transcriptional markers, indicating the vulnerability of the limbic system in radiation exposure. Understanding the mechanism by which ionizing radiation affects epigenetic programming will provide insight into the transmissibility of external factors to biological systems. Additionally, this work can aid the development of protective strategies against the harmful risks associated with radiation exposure.

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