Detection of extrachromosomal circular DNA (eccDNA) in ionizing radiation exposed cells

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Radiation therapy is an effective treatment for cancer patients. Ionizing radiation induces DNA double strand breaks causing deletions of DNA fragments from chromosomal regions. This cellular damage leads to cell death. It is assumed that fragmented DNA is degraded via nuclease action and the resultant nucleotides are recycled in the cell. We hypothesized that the DNA fragments generated during radiation-induced cellular damage are preserved as circular DNA and exist in the cells as extrachromosomal DNA. The DNA transition from a linear form to a circular form would provide protection from degradation by nucleases. Recent studies have indicated that some DNA fragments are naturally preserved after separation from chromosomal DNA in germ cells. The function of these extrachromosomal DNA in the cells is unknown. The goal of this study was to determine whether DNA fragments formed by ionizing radiation action are preserved in the cell as extrachromosomal circular DNA. Human cells were exposed to ionizing radiation and eccDNA was isolated using alternating nuclease steps. The eccDNA was visualized by transmission electron microscopy. We detected the presence of eccDNA in irradiated cells confirming our hypothesis. These results suggest that eccDNA is formed after ionizing radiation treatment in cells. Future studies involving sequence analysis of eccDNA will lead to understanding of its role in radiation-treated cells.