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Lethal effect of K-shell photoionization of phosphorus on radiosensitive cell lines

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Introduction

DNA is considered to be the critical target for cell killing by ionizing radiation. Therefore it is expected that the photoionization of phosphorus in DNA may cause some specific biological effects[1].

Many radiosensitive mammalian mutant cell lines have been established in these 40 years. They lack at least one gene which is involved in DNA repair system. By the complementation test, these cell lines are classified into at least 9 groups. Most of these genes have already been cloned in these several years. The usage of these mutants should help to clarify the nature of DNA damage.

These facts prompted us to test the lethality caused by K-shell photoionization of phosphorus in some radiosensitive mutant cell lines. We already reported the lethality of 4 mutant cell lines (SX9 is grouped as XRCC7 which is defective in DNA-PKcs, SX10 defective in DNA ligase IV[2], irs1 defective in XRCC2 and irs1SF defective in XRCC3[3]) and 1 normal cell line (FM3A which is the wild type parents of SX9 and SX10) [4]. This year, we will report the results for other cell lines.

Materials and Methods

Cells

A radiosensitive mutant cell line of M10 (derived from mouse leukemia and defective in XRCC4) and parental cell line of L5178Y were used. XRCC4 gene is involved in non-homologous end-joining which is one of the pathway of the DNA double strand break repair. Cells were cultured in suspension in plastic culture bottles with alpha-MEM medium with 10% fetal bovine serum and antibiotics.

Exposure

Monochromatic X-rays at 2.153 keV (K-shell resonance absorption peak of phosphorus), 2.146 keV and 2.160 keV (off peak) were selected for irradiation by an InSb double-crystal monochromater at BL-27A. Exponentially growing cells were placed on an isopore membrane filter (0.4 micrometer pore size, MILLIPORE). A plastic dish, in which an isopore membrane was placed, was set on a sample scanning stage to make uniform irradiation with X-rays. After irradiation, cells were plated in appropriate number and cultured in multi-well dishes for the colony formation.

Results and Discussions

Survival curves of L5178Y and M10 cells after x-rays irradiation were shown in Fig.1. Linear-quadratic survival curves were obtained for three energies. Lethal effect at 2.153 keV was larger than that at 2.146 keV in both cell lines. Lethal enhancement ratio (LE), which was defined as the ratio of 10% survival dose at 2.153 keV to that at 2.146 keV, was 1.4 for L5178Y and 1.3 for M10. LE values were slightly smaller than those of wild-type SR-1 cells[4] and irs1 and irs1SF [3]reported previously but very similar to those of SX9 and SX10[2].

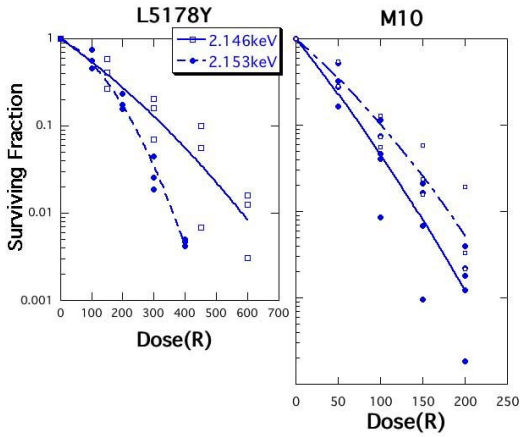

Fig.1 Survival curves of L5178Y and M10 cells. One R corresponds to 2.58 x 10^{-4} C/kg.

References

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