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THE ESTABLISHMENT OF RELATIVE BIOLOGICAL EFFECTIVENESS OF CARBON ION RADIATION IN ZEBRAFISH TESTES *

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With the development of nuclear technology, the risk of exposure to ionizing radiation (IR) becomes greater during radiotherapy used by carbon ions, the release of multiple radioisotopes following nuclear accidents, and the high-energy ions encountered during space missions [1]. Thus, the development of methods to reveal the harmful mechanism of IR is necessary. The process of spermatogenesis involves multiple spermatogenic cells in the testis, which is one of the most radiosensitive organs [2]. Radiation can induce necrosis, autophagy, apoptosis, premature senescence, and accelerated or delayed differentiation in germ cells, leading to cell death. We have shown that high linear energy transfer (LET) ions can seriously damage mouse testis and induce apoptosis of spermatogenic cells [3]. This process directly involves mitochondria since mitochondrial pathways appear to regulate heavy ion radiation (HIR) -induced apoptosis in spermatogenic cells [3]. This study compared the relative biological effectiveness (RBE) of carbon ion radiation (CIR) and X-ray irradiation in zebrafish testes at 7 days after irradiation. The logarithmic dose-response curves for the percentage of testes weight are shown in Fig. 1. At 7 days after irradiation, the X-ray dose for 50% reduction of testes weight was 13.2, the CIR dose for 50% reduction of testes weight was 8.86, the RBE of CIR in zebrafish testes was calculated as 1.48. From the dose-dependent curve, when testes weight was reduced to 70%, the dose of CIR was 3.8 Gy. Coincidentally, 4 Gy is commonly used as a high dose single-fraction. Although such a dose can increase long-term survival in childhood cancer patients, it increases the risk of infertility. Therefore, we chose 4 Gy as a single-fraction of high dose in radiotherapy or to simulate the one-off high dose or long−term accumulation of radiation under radiation environment.

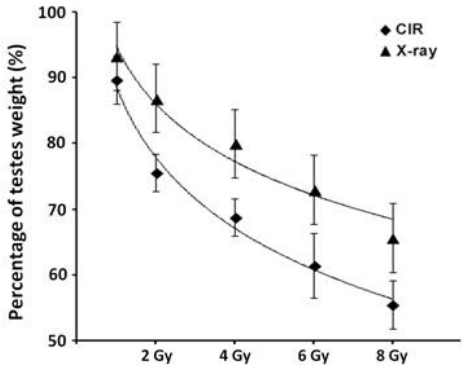

Fig.1. The RBE of CIR in zebrafish testes and the different biological effect in testicular cells apoptosis between X-ray and CIR.

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