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Sperm Abnormalities in the Caudal Epididymis of High- and Low-dose-rate γ-Irradiated Korean Dark-striped Field Mice, *Apodemus agrarius coreae*

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Introduction

The harmful effects of high-dose radiation on living organisms, including humans and animals, have been well-demonstrated through the findings of epidemiological studies of the effects of the atomic bombings in Hiroshima and Nagasakiand the Chernobyl nuclear accident Currently, a large number of studies are being conducted on the systemic effects of low-dose radiation these studies have been performed using both *in-vivo* and *in-vitro* systems. However, there have been few studies on the effects of low-dose (≤200 mGy) and low-dose-rate (LDR, ≤6 mGy/h) irradiation on spermiogenesis in small experimental animals.

The effects of radiation on humans and animals are manifested in form of miscarriages, stillbirths, congenital malformations, and cancers; these effects occur as a result of genetic defects in paternal germ cells. It is well-known that genome instabilities in parental germ cells are spontaneously transferred to the next generation. However, it is difficult to precisely identify their response to radiation by using currently reported endpoint markers (apoptosis, gene mutation, repair capabilities, and chromosome aberrations of spermatogonia), since the testicles contain developmental stages of germ cells. Recently, we have conducted studies on the abnormalities of sperms in the caudal epididymis to investigate whether the genetic damage in the spermatogonial stem cells induced by LDR irradiation are transmitted to the next generation. Interestingly, our previous data showed that LDR (0.7 mGy/h) radiation does not damage spermatogonial stem cells and instead stimulates repair in these damaged cells in ICR mice. However, the relationships between the frequency of sperm abnormalities and the total accumulated dose with continuous LDR irradiation have not been

investigated in Korean dark-striped field mice, *A. a. coreae*. In this study, we analyzed the frequency of sperm abnormalities in low- (0.7 mGy/h) and high-dose-rate (HDR, 0.8 Gy/min) irradiated Korean dark-striped field mice, *A. a. coreae*. We also determined the ratio of the dose-rate effect in the LDR γ-irradiated mice to that in the HDR γ-irradiated mice. This is the first report of the effects of radiation on spermatogenic cells in Korean dark-striped field mice, *A. a. coreae*.

Materials and Methods

Animals : Seven-week-old male dark-striped field mice were used in this experiment. Taxonomy, breeding of field collected A. a. coreae from Korea and the donation of offspring F1 mice for this experiment were the same as the protocols reported by Kim et al.[1)]

Irradiations : A γ-ray generator (IBL 147C CIS Bio International, France) was used for the production of the HDR irradiation (^{137}Cs, 0.8 Gy/min), and the Long-term Low-dose Irradiation Facility at the RHRI was used for the production of the LDR (^{137}Cs, 0.7 mGy/h) radiation.

Sperm observations: The caudal epididymis was collected from the irradiated mice on the 8th day, when the sperms from the testicles reach the caudal epididymis.[2)]

Results and Discussion

Morphological characteristics of the sperms obtained from the caudal epididymis of the irradiated mice were analyzed, and the overall frequency of sperms with abnormal morphology in the high- and LDR irradiated mice was compared (Fig. 1). The radiation effects in spermatogenic cells of Korean dark-striped field mice, *A. a coreae* can be summarized as follows. Firstly, the number of abnormal sperms in caudal epididymis of the HDR irradiated mice increased after exposure to 0.5 Gy of radiation. Secondly, the occurrence of abnormal sperms during spermatogenesis can probably be suppressed by LDR radiation. We also suggested that rather than causing damage, LDR γ-irradiation induced repair mechanisms during spermatogenesis.

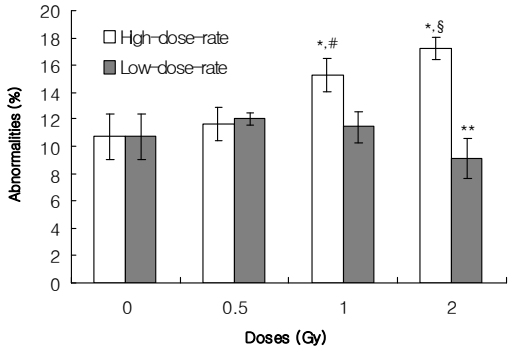

Fig. 1. Frequency of sperm abnormalities in the caudal epididymis of high- and LDR γ-irradiated *A. a. coreae*. P = 0.003: HDR *vs* LDR irradiated mice. * P < 0.01: 1 and 2 Gy *vs* 0 and 0.5 Gy after HDR irradiation. ** P = 0.03: 0.5 Gy *vs* 2 Gy after LDR irradiation. # P = 0.038: 1 Gy irradiation with LDR *vs* HDR. P = 0.006: 2 Gy irradiation with LDR *vs* HDR. n = 5/group.

References

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