1. Title
FY2005 Ground-based Research Program for Space Utilization Research Report

2. Research Term
FY2005〜2007

3. Research Fields
Life Sciences

4. Research Categories
Incoming Research for Space Utilization

5. Research Theme
Risk of Cosmic Radiation on Human Organs and Tissues Maintained in SCID Mice and Transgenerational Effects

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8. Summary of Research
To study the risk of cosmic radiation, especially on neutron which is a major component of radiation in the flying body and space base, two projects were carried out: (1) Effects on human organs and tissues maintained in super-SCID (severe combined immunodeficient) mice which are defective of T cell and B cell functions, and (2) Transgenerational effects in the offspring of mice exposed to radiation.

[Results]
1) Effects of cosmic radiation on human tissues maintained in SCID mice.
(1) We prepared large numbers of super SCID mice, C57BL/6JNOS-scid/scid to maintain human thyroid tissues from Graves’ disease, transplantable lung tissues from human embryo and human bone marrow cells for space research.
(2) Morphology and function (hormone secretion) were injured by high doses and high dose rate of X- and γ-rays (9-33 Gy) and reactor neutron (0.2 Gy x 6), but not by same doses with low dose-rate of γ-rays, showing apparent dose rate effects in human thyroid tissues.
(3) Mutations of cancer related genes were induced in human thyroid tissues by large doses and high dose rate of γ-rays (9-33 Gy), but no mutations were found after very low dose rate γ-ray exposures, indicating apparent dose rate effects in human thyroid tissues.
tissues. Neutron doses (0.2 Gy x 2) were not enough to produce mutation and cancer in the human lung tissue.

(4) Neutron (0.2 Gy x 4) induced bigger changes in gene expression in the human lung tissue than 2 Gy of γ-rays, suggesting high RBE of neutron.

2) Transgenerational effects in the offspring

(1) Microsatellite mutations were induced dose-dependently in the offspring (926 mice) of the N5 male mice exposed to 0.2 and 0.4 Gy of neutron.

(2) Significantly high incidence of lymphocytic leukemia were induced in the offspring (722 mice) by reactor neutron. The incidence was 10-20 folds higher than our former X-ray and γ-ray studies, again suggesting high RBE.

[Perspectives]

1) We are ready to launch the SCID mice with human organs and tissues to examine the effects of cosmic radiation in the space. However, experimental rooms should be SPF (specific pathogen free).

2) Small numbers of N5 male mice are enough to launch into the space. Large numbers of offspring are produced by mating with N5 females after returning. We have to examine lower doses of neutron and combination effects with environments after birth.

3) Studies with model mice for human diseases are proposed, and such studies are going on with pharmaceutical companies and heavy industries.

9. Publication List


10. URL