Transgenerational Effects in Mice Exposed to Continuous Low Dose-rate Gamma-rays – Analysis of Germ Cell Mutation –

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Abstract

Transgenerational effects of continuous low dose-rate (LDR) gamma-rays irradiation of male mice have not been well studied. The incidence of copy number aberrations (CNAs) in the progeny of male C57BL/6J mice continuously exposed to LDR (20 mGy/22 h/day, 0.05mGy/22 h/day) gamma-rays for 400 days (total dose: 8000 mGy) was analyzed. Using oligo-microarray CGH (Agilent Technologies), we analyzed a total of 391 genomes (111 progenies from 20 pairs of parents in the 20 mGy/22 h/day irradiated group, 46 progenies from 6 pairs of parents in the 0.05 mGy/22 h/day irradiated group and 140 progenies from 20 pairs of parents in the non-irradiated group). Progeny from the 20 mGy/22 h/day irradiated mice had significantly higher frequencies of genomic aberrations than progeny from the non-irradiated mice. Mice containing more than five mutations were found only in the irradiated groups, whereas no such mice were found in the non-irradiated group. The F_1 mice with CNAs had the tendency to have a short life span in both the irradiated and non-irradiated groups.

Table 1 Number of mice and loci with aberrations

		No. of F_1 mice analyzed	No. of mice with aberrations	No. of loci with aberrations
20 mGy/ 22h/day irradiated group	♀	48	10 (22.9 %)	25 (Ave. 0.34 /generation)
	♂	63	14 (22.2 %)	150 (Ave. 2.38 /generation)
	♀+♂	111	24 (22.5 %)	175 (Ave. 1.58 /generation)
0.05 mGy/ 22h/day irradiated group	♀	21	2 (9.5 %)	2 (Ave. 0.10 /generation)
	♂	25	3 (12.0 %)	41 (Ave. 1.64 /generation)
	♀+♂	46	5 (10.8 %)	43 (Ave. 0.93 /generation)
Non irradiated group	♀	73	9 (12.3 %)	10 (Ave. 0.12 /generation)
	♂	67	6 (9.0 %)	12 (Ave. 0.18 /generation)
	♀+♂	140	15 (10.7 %)	22 (Ave. 0.16 /generation)

Table 2 Relationship between the presence of aberrations and life span in F_1 mice

		Aberrations	Life span (day)	Cause of death		
				Category	Major	
20 mGy/ 22h/day irradiated group (111 mice)	♂	Yes 13(20.6%)	794.8 ±170.7	Neoplasms 8 (66.6%) Inflammation 1 (8.3%) Others 3 (25.0%)	Lymphoma, Malignant	38%
		No 50(79.3%)	843.7 ±231.2	Neoplasms 23 (48.9%) Inflammation 13 (27.7%) Others 11 (23.4%)	Lymphoma, Malignant	14%
	♀	Yes 11(22.9%)	706.1 ±182.7	Neoplasms 9 (81.8%) Inflammation 1 (9.1%) Others 1 (9.1%)	Lymphoma, Malignant	45%
		No 37(77.1%)	799.8 ±154.3	Neoplasms 29 (78.4%) Inflammation 4 (10.8%) Others 4 (10.8%)	Lymphoma, Malignant	43%
non irradiated group (140 mice)	♂	Yes 7(10.4%)	787.9 ±340.5	Neoplasms 3 (42.9%) Inflammation 2 (28.6%) Others 2 (28.6%)	Lymphoma, Malignant	14%
		No 60(89.6%)	905.5 ±172.2	Neoplasms 34 (58.6%) Inflammation 14 (24.1%) Others 10 (17.2%)	Lymphoma, Malignant	22%
	♀	Yes 9(12.3%)	699.0 ±167.0	Neoplasms 7 (77.8%) Inflammation 0 (0.0%) Others 2 (22.2%)	Lymphoma, Malignant	67%
		No 64(87.7%)	804.5 ±158.5	Neoplasms 43 (69.4%) Inflammation 12 (19.4%) Others 7 (11.2%)	Lymphoma, Malignant	41%