Physiological and immunological changes following exposure to low versus high-dose ionizing irradiation; comparative analysis with dose rate and cumulative dose

Heesun Kim*, Heewon Jang, Soungyeon Song, Shinhye Oh, Cukcheul Shin, Meeseon Jeong, Chasoon Kim, Kwnaghee Yang, Seonyoung Nam, Jiyoung Kim, Youngwoo Jin and Changyoung Cha

Radiation Health Research Institute, Korea Hydro & Nuclear Power Corporation, 388-1, SSangmun-dong, Dobong-ku, Seoul 132-703, Korea

Abstract

While high-dose of ionizing radiation is generally harmful and causes damage to living organisms some reports suggest low-dose of radiation may not be as damaging as previously thought. Despite increasing evidence regarding the protective effect of low-dose radiation, no studies have directly compared the exact dose-response pattern by high- and low-dose of radiation exposed at high-and low-dose rate. This study aims to explore the cellular and molecular changes in mice exposed to low- and high-dose of radiation exposed at low- and high-dose rate. When C57BL/6 mice (Female, 6 weeks) were exposed at high-dose rate, 0.8Gy/min, no significant change on the level of WBC, RBC, or platelets was observed up to total dose of 0.5Gy. However, 2Gy of radiation caused dramatic reduction in the level of white blood cells (WBC) and platelets. This reduction was accompanied by increased DNA damage in hematopoietic environments. The reduction of WBC was mainly due to the reduction in the number of CD4+ T cells and CD19+ B cells. CD8+ T cells and NK cells appeared to be relatively resistant to high-dose of radiation. This change was also accompanied by the reduction of T- and B- progenitor cells in the bone marrow. In contrast, no significant changes of the number of CD4+ T, CD8+ T, NK, and B cells were observed in the spleen of mice exposed at low-dose-rate (0.7mGy/h or 3.95 mGy/h) for up to 2Gy, suggesting that low-dose radiation does not alter cellular distribution in the spleen. Nevertheless, mice exposed to low-dose radiation exhibited elevation of VEGF, MCP-1, IL-4, Leptin, IL-3, and Tpo in the peripheral blood and slight increases in MIP-2, RANTES, and IL-2 in the spleen. This suggests that chronic γ-radiation can stimulate immune function without causing damage to the immune components of the body. Taken together, these data indicate hormesis of low-dose radiation, which could be attributed to the stimulation of immune function. Dose rate rather than total dose appeared to be more critical in switching effect from the damage side toward the hormesis.

KEYWORDS: *Low-dose and low-dose-rate radiation, Immunology, Cytokines, Hormesis*

Presenting author, e-mail: hskimdvm@khnp.co.kr