Countermeasures for the Biological Effects of Space Radiation

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Exposure to the types of ionizing radiation encountered during space travel is expected to increase the risk for cancer induction in astronauts. The primary types of radiation of particular concern for the astronauts are protons and particles of high atomic number and high energy (HZE particles). The hypothesis to be tested in our research program is that control of radiation induced oxidative stress will reduce the risk of cancer development. Our current studies are designed to determine the types of dietary supplement agents or agent combinations that will be the most effective at reducing the level of oxidative stress associated with exposure to ionizing radiation in space. The supplements being evaluated include the following as single agents or as combinations: vitamins C, E, folic acid, glutathione, N-acetyl cysteine, selenium, lipoic acid, niacin, thiamin, Co-enzyme Q10 and the soybean-derived Bowman-Birk inhibitor. The efficacy of the dietary supplement agents is being evaluated in cultured human cells and Sprague-Dawley rats, in which the effects of the dietary supplement agents on the baseline levels of oxidative stress and radiation induced oxidative stress are being determined. For all studies being performed as part of this program, surrogate endpoint biomarkers of carcinogenesis are being monitored, including bio-reduction capacity and oxidative stress in cells and animals. Oxidative stress is measured by the dichlorofluorescein (DCF) fluorescence assay and the protein carbonyl measurement. We have observed that L-selenomethionine and several different types of antioxidants can protect against radiation induced oxidative stress produced by photons, protons and 1 GeV iron cells in cultured cells and in animals. Significantly increased levels of oxidative stress have been observed in cells irradiated with doses of protons or 1 GeV iron ions as low as 5 cGy.

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