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SPACEFLIGHT AND RADIATION INDUCES MICROVESSEL AND STRUCTURAL DAMAGE IN OCULAR TISSUE

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There is a concern that degradation of vision as a result of space flight may compromise both mission goals and long-term quality of life after space travel. Degradation of vision associated with space travel may be due to a combination of gravitational changes and exposure to ionizing radiation. The retina and the retinal vasculature also play important roles in vision. Nonetheless, the retina and the retinal vasculature have not been studied extensively in relation to space travel and space radiation. The goal of the present study was to characterize the oxidative damage and induction of apoptosis in retinal endothelial cells after whole-body irradiation exposure of 0.1 to 1 Gy with of 600 MeV/n ¹⁶O ions, 150 MeV/n protons or ⁶⁰Co gamma rays. We also investigate spaceflight environment-associated retinal damage from mice flown in the space shuttle Atlantis (STS-135). The role of antioxidant MnTE-2-PyP in protecting the ocular tissue and retinal microvessels from radiation damage was also evaluated. Our study revealed that exposure to low-dose ionizing radiation induced oxidative damage and apoptosis in the retina. Significant changes in retinal endothelial cells occur at doses as low as 0.1 Gy. There were significant differences in the responses of endothelial cells between radiation types. Our flight study revealed that spaceflight conditions induced significant apoptosis in the retina especially inner nuclear layer (INL) and ganglion cell layer (GCL) compared to ground controls. The data provided the first evidence that spaceflight conditions induce oxidative damage that results in mitochondrial apoptosis in the retina. This data suggest that astronauts may be at increased risk for late retinal degeneration. Our results also demonstrated that MnTE-2-PyP has protective effects on photoreceptor and retinal capillary from radiation damage, suggesting metalloporphyrin antioxidants may play an important role regulating the oxidative damage induced by radiation.

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