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THE DEVELOPMENT AND FORMATION OF BLOOD MALIGNANCIES IN ASTRONAUTS AND SPACE TRAVELERS AS A RESULT OF COSMIC RADIATION DURING DEEP SPACE TRAVEL

Abstract

Purpose: The continuous development of technology and curious nature of human beings will soon allow us to travel into deep space and progress further in our endeavors of human space exploration. Different nations, government agencies, private companies and research institutes around the world are working towards deep space missions in the near future, including sending humans back to the moon, to Mars and beyond. Such goals come with benefits to human society but place humans farther away from the protection of the Earth's magnetosphere in low Earth orbit (LEO) and expose them to higher doses of space radiation. The hematopoietic system responsible for production of blood and renewal of stem cells for tissue regeneration is radiosensitive and vulnerable to space radiation, making it an important system to explore in preparation for deep space travel. Perturbation of normal hematopoietic function can lead to three main types of blood cancers: leukemia, lymphoma, and myeloma. Studying the effects of space radiation within the context of space travel and oncology medicine is of high interest in today's world as cancer is a serious risk of long-distance manned space travel. Methodology: A comprehensive review of all available evidence ever reported of the impact of high and low energy radiation exposure during spaceflight, simulated studies, and radiotherapy towards blood cancer was conducted, including scientific and clinical data. Results: The evidence in our review suggest leukemia is greatly influenced by ionizing radiation and may be the prominent blood cancer observed in deep space travel. This is highly relevant when assessing the overall risk of space travelers into deep space, and screening those with genetic or hereditary tendencies to develop leukemia. Also, our work encourages the design of appropriately targeted therapies or countermeasures like radioprotectors and novel materials to protect from such dangers, mitigate the risks and allow the development of a predictable health risk model. Conclusions: Our work at the Mayo Clinic has allowed a better understanding of the effects of space radiation, specifically ionizing radiation, towards the development and/or survival of these cancers, especially leukemia. This is particularly important for healthcare practitioners and members of the medical community who will encounter and treat altered physiology and disease states of space travelers returning from deep space travel. We hope our review and subsequent studies will help to identify potential expected blood malignancies in people who will embark on deep space travel and find solutions for them.