Exposure to space radiation reduces ability of intestinal cells to destroy oncoprotein

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Two studies funded by NASA and presented at the AACR Annual Meeting 2013 help explain why space radiation may increase the risk of colorectal cancer in humans.

The researchers, from Georgetown Lombardi Comprehensive Cancer Center, found that cosmic radiation impairs the ability of cells in the intestines of mice to eliminate oncogenic proteins, thus substantially increasing development of colorectal tumors.

The findings are important because they might provide a direction for researchers in designing strategies to protect space travelers against increased cancer risk, say the scientists, Shubhankar Suman, PhD, and Kamal Datta, MD. Both scientists are involved in a NASA Specialized Center of Research (NSCOR), directed by the Molecular Cancer Research Chair at Georgetown Lombardi, Albert Fornace Jr., MD.

"While there is no reliable estimate of colorectal cancer risk from space radiation exposure, we have shown that exposure to cosmic radiation causes markedly increased intestinal tumors in mice," says Datta, an assistant professor in the department of biochemistry and molecular & cellular biology.

"These findings have implications for the health of astronauts undertaking exploratory missions into outer space and for future space tourists," he says.

"Our objective is to develop a risk estimate based on mouse model studies and to identify molecular mechanisms contributing to it, so that we can develop strategies to protect astronauts during long duration space missions, such as one to Mars," says Fornace, director of the NASA program at Georgetown.

Both researchers used specialized mutant mice to study the effects of 56Fe radiation, a highly ionizing radiation prevalent in space. "This radiation is considered the greatest challenge for space exploration," says Datta. "It deposits higher amount of energy in the body than does the gamma-/x-rays causing relatively higher DNA damage. This is believed to increase carcinogenic risk in astronauts, although accurate risk estimates are not yet available."

Georgetown researchers also report that 56Fe radiation significantly increased colorectal cancer risk in mouse models of colorectal cancer through enhanced activity of beta-catenin, an oncogene that activates expression of pro-growth genes in the colon.

In his study (abstract #3600), Datta reports that tumor formation in mouse intestines after exposure to cosmic radiation, unlike after exposure to gamma radiation, was dose dependent.

"Sustained exposure during prolonged space missions such as a mission to Mars and lengthy stays at the International Space Station may cause significant cosmic radiation dose accumulation in astronauts and thus remains a long-term health concern of space exploration," says Datta.

In his study (abstract #428), Suman, a postdoctoral fellow in the department of biochemistry and molecular biology, report that cancer causing beta-catenin levels are increased because cosmic radiation reduces the cell's ability to tag beta-catenin proteins for destruction. That means intestinal cells cannot degrade this cancer causing protein allowing uncontrolled cell growth.

"Knowing how space radiation induces tumor formation will allow us to develop preventive strategies that target this specific signaling pathway," Suman says.

Provided by Georgetown University Medical

Center

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