Scientist-astronaut sends T-cells into space

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A former astronaut and researcher at the San Francisco VA Medical Center will be traveling to the Cosmodrome space-launch site at Baikonur, Kazakhstan, this Saturday, Sept. 2, 2006, to prepare a crucial experiment designed to demonstrate how human immune response is suppressed in the weightless environment of space.

Millie Hughes-Fulford, PhD, director of the Laboratory of Cell Growth at SFVAMC, scientific advisor to the Under Secretary of the U.S. Department of Veterans Affairs, and a payload specialist aboard space shuttle flight STS-40 in 1991, will send human T-cells up to the International Space Station aboard ISS Soyuz 13. That science mission, operated by the European Space Agency, is scheduled to launch from Baikonur between September 14 and September 18, 2006.

"We're doing this experiment because many astronauts are immunosuppressed during flight. Their T-cells stop working in microgravity," says Hughes-Fulford, who is also an adjunct professor of medicine at the University of California, San Francisco. "This experiment will tell us for the first time exactly which genes involved in the normal immune response aren't activated in space."

T-cells are white blood cells that play a central role in the body's immune response. They are a target of human immunodeficiency virus (HIV), which suppresses them. When an HIV patient's T-cell count falls below 200, he or she is susceptible to the dangerous infections that are the symptoms of acquired immunodeficiency syndrome (AIDS).

The problem of immunosuppression in microgravity was first noted during the Apollo moon mission series in the 1960s and 1970s, when 15 out of 29 Apollo astronauts developed infections during their missions or soon after landing. Subsequent experiments aboard Skylab and several space shuttle missions, including Fulford's, confirmed that T-cells do not activate properly in microgravity.

"In this experiment, we're looking at why they're not working," says Hughes-Fulford. "Normally, in order for T-cells to be activated, certain genes have to be expressed in a certain order, in what's called a signaling pathway. Aboard the ISS, we hope to find exactly which genes are not being expressed in microgravity."

The experiment will be carried to the International Space Station inside a specially designed incubator called Kubik, which was made to fit precisely under the cosmonaut's seat in the Soyuz spacecraft. Kubik contains a compartment for weightless experiments as well as a centrifuge that can accelerate cells in a range from 0.2 to 2 earth gravities.

On board the space station, European Space Agency astronaut-scientist Thomas Reiter will simultaneously activate T-cells in the weightless compartment and in the centrifuge for four hours. "By activating the cells, he'll be simulating the activation that normally occurs in response to infection," Hughes-Fulford explains. "He'll be setting up the whole cascade that would normally turn on the T-cells. Except we know that some of the genes will not turn on because they're in a weightless environment."

At the end of the experiment, the T-cells will be safely packaged and then sent back to Earth aboard the returning Soyuz craft. In her VA lab in San Francisco, Hughes-Fulford will analyze the results.

"Our expectation is that the T-cells in the centrifuge – basically, under artificial gravity – will be activated normally, and the T-cells in microgravity will not be activated," she predicts. "We will compare them side by side and discover, for the first time, exactly which genes did not turn on in microgravity."

Hughes-Fulford placed an earlier version of the same experiment aboard the space shuttle Columbia on shuttle mission STS-107. At the end of that mission on February 1, 2003, the Columbia broke up upon reentry into Earth's atmosphere, killing all seven crew members and destroying all experiments aboard.

"We cannot go to Mars, or even to the Moon over the long term, without knowing more about why T-cells are not working," says Hughes-Fulford. "When we learn that, we can start looking for possible treatments."

Source: University of California - San Francisco