Mission Ax-2 set to launch stem cells to space

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Ax-2 Mission Patch. Credit: NASA

Cedars-Sinai investigators, in collaboration with Axiom Space of Houston, are sending stem cells to space in early May to explore whether microgravity can make it easier and more efficient to produce large batches of stem cells.

This is the first of a series of missions funded by NASA where, for the

first time, induced pluripotent stem cells (iPSCs) will be manufactured in space by astronauts.

Astronauts on the International Space Station will grow and differentiate the stem cells to see whether microgravity has any impact on the way the cells develop into other cell types like brain and heart cells.

"A major challenge for using iPSCs for therapies in humans is making enough of them at very high quality," said co-principal investigator Arun Sharma, Ph.D., a stem cell biologist in the Board of Governors Regenerative Medicine Institute and Smidt Heart Institute at Cedars-Sinai. "We want to be able to mass-produce them by the billions so that we can utilize them for a number of different applications, including discovering new drugs that may be able to improve heart function. And while we've gotten better at this over the last few years, there are still certain limitations when it comes to production of these stem cells, and we think microgravity may be able to overcome some of these."

A pluripotent stem cell is a very powerful type of cell that has been reprogrammed from an adult cell to go back in time to a powerful state of "pluripotency," in which the cell can be turned into nearly any cell type found in the human body. Once in this state, it can then be developed into models of disease and used for tailored treatments.

However, one of the main issues with producing iPSCs on Earth may involve gravity-induced tension, which makes it hard for cells to expand and grow. In a low-gravity environment, this stress may no longer present a barrier, potentially making it easier for stem cells to multiply faster.

"Gravity constantly pulls these pluripotent stem cells towards Earth, putting pressure on them and providing a stimulus to start turning into other cell types, but in microgravity that effect will no longer be there,"

said Clive Svendsen, Ph.D., executive director of the Cedars-Sinai Board of Governors Regenerative Medicine Institute and co-principal investigator on the mission. "When the stress of gravity is not there pulling on the cells, we want to test whether they grow faster, have fewer genetic changes and remain in the pluripotent state. Then, when we turn them into the critical cells we need for health care, we will see if they do it better in microgravity. That is the goal of this new mission, and we are all very excited to see what happens up there."

The upcoming missions also combine the stem cell expertise of Dhruv Sareen, Ph.D., and his team, who are already manufacturing clinical-grade stem cells at the Cedars-Sinai Biomanufacturing Center and are collaborators on the NASA grant.

Mission details

No earlier than May 8, a SpaceX Falcon 9 rocket will launch the Ax-2 crew aboard a Dragon spacecraft to the International Space Station from Launch Complex 39A at NASA's Kennedy Space Center in Florida.

The Cedars-Sinai team, which also includes postdoctoral fellow Maedeh Mozneb, Ph.D., and research associate Madelyn Arzt, will be on site for a week at the Kennedy Space Center to prepare the stem cells and load them onto the Dragon spacecraft. The first mission will be approximately one week in duration and is in preparation for longer missions in the months to come. Stem cells will be examined for how well they divide and take up DNA during spaceflight.

"It is exciting to see the wide range of important research that will be conducted on this mission and to be taking the first steps in developing future in-space manufacturing applications for some of our biomedical products," said Christian Maender, executive vice president of in-space solutions at Axiom Space. "We are pleased to have the opportunity with

our private astronaut missions to advance this important work as we build a future commercial space economy."

Provided by Cedars-Sinai Medical Center