Mice flown in space show nascent liver damage, researcher says

April 20 2016

Credit: martha sexton/public domain

In a discovery with implications for long-term spaceflight and future missions to Mars, a researcher at the University of Colorado Anschutz

Medical Campus has found that mice flown aboard the space shuttle Atlantis returned to Earth with early signs of liver disease.

"Prior to this study we really didn't have much information on the impact of spaceflight on the liver," said the study's lead author Karen Jonscher, PhD, an associate professor of anesthesiology and a physicist at CU Anschutz. "We knew that astronauts often returned with diabetes-like symptoms but they usually resolved quickly."

But the prospect of liver damage raises new concerns.

The mice studied spent 13.5 days aboard the space shuttle. When they returned, Jonscher and her colleagues were able to collect liver samples. They found that spaceflight appeared to activate specialized liver cells that may go on to induce scarring and cause long-term damage to the organ.

"We saw the beginning of nascent liver damage in just 13.5 days," Jonscher said. "The mice also lost lean muscle mass. We have seen this same phenomenon in humans on bedrest - muscles atrophy and proteins break down into amino acids. The question is, how does that affect your liver?"

For years scientists have studied the impact of spaceflight on human physiology but most of the research has focused on bone, muscle, brain and cardiovascular function. Yet studies suggesting that astronauts who spent time in space developed diabetes-like symptoms link microgravity with metabolism and point toward the liver, the major organ of metabolism, as a possible target of the space environment.

Whether or not the liver itself is vulnerable to damage has remained an open question. And this research may help answer that.

The mice spent time orbiting the Earth on the final space shuttle flight in 2011. Once they returned home, teams of scientists were allowed to share and study their internal organs.

Jonscher's team found that spaceflight resulted in increased fat storage in the liver, comparing pair-fed mice on Earth to those on the shuttle. This was accompanied by a loss of retinol, an animal form of Vitamin A, and changes to levels of genes responsible for breaking down fats. As a result, mice showed signs of nonalcoholic fatty liver disease (NAFLD) and potential early indicators for the beginnings of fibrosis, which can be one of the more progressive consequences of NAFLD.

"It generally takes a long time, months to years, to induce fibrosis in mice, even when eating an unhealthy diet," Jonscher said. "If a mouse is showing nascent signs of fibrosis without a change in diet after 13 ½ days, what is happening to the humans?"

With NASA planning longer deep space missions, including one to Mars which would take at least a year, these findings are significant.

"Whether or not this is a problem is an open question," Jonscher said. "We need to look at mice involved in longer duration space flight to see if there are compensatory mechanisms that come into play that might protect them from serious damage."

She pointed out that the stress of spaceflight and reentry to Earth might have also played a role in the liver damage.

"Further study in this area is merited and analysis of tissues harvested in space from mice flown aboard the International Space Station for several months may help determine whether long-term spaceflight might lead to more advanced hepatic injury and whether damage can be prevented," she said.

The study was published Wednesday in the journal *PLOS ONE*.

Provided by CU Anschutz Medical Campus