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Researchers explore medicine in the final frontier

Weightlessness doesn't affect anesthesia dose, UF scientists find

GAINESVILLE, Fla. - On Mars, Earth probably looks like a pinprick in the sky, a bluish-green ball some 140 million miles away. But before astronauts can glimpse the view from the red planet, doctors must better understand how to handle medical problems and surgeries in space, University of Florida researchers say.

Now preliminary findings from a UF study show there is little difference in the dose of general anesthesia needed to anesthetize patients in weightless or normal gravity environments. It's a major step forward, but just one of many hurdles researchers face in trying to establish proper medical protocols in space, UF researchers write in the October issue of the Journal of Gravitational Physiology.

"There are lots of little technical things that have to be thought through and tried out in order to translate what we consider normal medical care into a space environment," said Christoph Seubert, lead author of the National Aeronautics and Space Administration-funded study and a UF assistant professor of anesthesiology. "What (anesthesia) you use and how the drugs react is only a small part of the picture."

On shorter missions to orbit the Earth or to travel to the International Space Station, astronauts could get back to ground within a day if a medical emergency arose, but from Mars or even a lunar base, that's not possible, Seubert said. Depending where it is in orbit, the space station is usually 200 to 600 miles from the Earth's surface. The moon is about 238,000 miles from Earth.

Mars, meanwhile, varies in distance from 35 million miles to more than 200 million miles away from the Earth, depending on its orbit, but is on average about 140 million miles away. A trip to the red planet would likely be a three-year endeavor for astronauts, Seubert said.

French doctors recently performed the first surgery in weightless conditions, operating during an airplane flight designed to mimic weightlessness. However, they used a local anesthetic and doctors still need to understand the effects of general anesthesia, the method of sedation used in most surgeries. Prior to UF's study, the only real data showing how weightlessness affects general anesthesia came from a mission in which two Rhesus monkeys were sent to space. When the monkeys returned to Earth, surgeons performed minor biopsies on them as part of their study. One of the monkeys died, presumably because of an interaction with anesthesia, Seubert said.

So far, UF researchers have found no distinct differences providing anesthesia intravenously in simulated weightless or normal gravity conditions. Seubert said differences are actually greater between individuals, who require varying amounts of anesthesia, a phenomenon that happens no matter where the surgery occurs.

To simulate weightlessness, participants in the ongoing UF study are confined to strict bed rest, with their bodies tilted six degrees head down.

"The normal gravitational vector is from the head to the feet, so if you put somebody slightly head down, that completely offloads the musculature, the skeleton and the circulation, and it causes adaptations in bone, muscle and circulation that are very similar to real spaceflight, minus the nausea that comes with not having gravity," Seubert said.

Aside from understanding how anesthesia affects the body during and after spaceflight, researchers also must analyze even the smallest details to ensure astronauts receive proper medical care in outer space, Seubert said. On Earth, when patients are given anesthesia through intravenous tubes, the bags hang from racks and gravity pushes up any air bubbles that may be mixed in with the drug. In space, however, air bubbles and medicine would mingle, potentially allowing bubbles to be infused into patients, Seubert said.

Medicine taken orally also seems to work differently in space, Seubert said. This could be because spaceflight is a nauseating experience, and nausea may affect the digestion of drugs taken by mouth, he added.

Seubert's findings pinpoint all the issues physicians must face in order to care for patients during and after trips to space, said Jonathan Clark, M.D., a space liaison for the National Space Biomedical Research Institute and president of the Space Medicine Association.

"Given that commercial spaceflight is about to take off, I think this is a very important paper," Clark said. "I think this article should be required for anyone who is providing (medical) support (to astronauts)."

Although Clark said he thinks the first mission to Mars is probably at least 20 to 30 years away, scientists still have much to do to ensure astronauts receive proper medical care, whether they are on Mars, the moon or back on Earth.

"The most important thing is to define what to treat (in space) and how to do so," Seubert said. "There are a lot of things we can do to make this better."

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