Medical treatments from 200 miles up

May 28 2012, By Katharine Gammon

The International Space Station (ISS) is backdropped over Miami, Florida, in this 35mm frame photographed by STS-108 Commander DomInic Gorie aboard the Space Shuttle Endeavour. Credit: NASA

In the hunt for cancer treatments, researchers have had some help from higher authorities -- way higher. The International Space Station, orbiting the Earth at more than 200 miles in the sky, houses scientific experiments that have led to advances in several medical fields.

Many things don't react the same way in the microgravity environment of space as they do on the ground. Back in 1998, during the shuttle program, now-retired NASA scientist Dennis Morrison began experimenting on microencapsulation, a process that forms tiny liquid-filled, biodegradable micro-balloons containing various drug solutions. It can provide better drug delivery and new medical treatments for solid tumors and resistant infections. Those encapsulated drugs could be

directly injected into a tumor and would go to work destroying the cancer from the inside out.

"The idea is that fluids don't behave in space the way they do here on Earth," explained Tara Ruttley, an associate International Space Station program scientist.

Harnessing space's unique environment of low fluid shear -- the motion of fluid around a living cell in space mimics that inside the body -- Morrison's first experiments showed it was possible to force two drugs together that would not combine in normal gravity.

The initial investigations were successful, so Morrison sent samples back for another eight experiments in encapsulation on the International Space Station in 2002 -- this time adding a coating of electrical charges that make these capsules invisible to the immune system.

He was also able to create larger microballoons that could carry drugs and position themselves to cut off blood flow to the tumor and stop its growth. The space-produced microcapsules as a cancer-treatment delivery system inspired the development of an Earth-based system that can replicate the quality of the microcapsules created in space.

The station research led directly to five U.S. patents that have been licensed by NASA and two more that are pending. Some of the technologies and methods have been licensed by commercial companies to develop new delivery methods, including better ultrasound-enhanced needles and catheters that could be used to deliver the microcapsules of anti-tumor drugs directly to tumor sites.

"What we see from space is really preliminary, but it has enormous potential," said Ruttley, who reported that a company has been approved for clinical trials to test the microcapsules.

Microencapsulation is a very powerful technique, but not quite ready for outer-space mass-production, said Margaret Wheatley, a professor of biomedical engineering at Drexel University.

"Smart microcapsules are now being developed to hone in on tumors and also to respond to triggers for controlling release," said Wheatley. "Certainly NASA's effort in microgravity contributes valuable insight, but regular use of microgravity manufacturing for health care is a long way off due to the extraordinarily high costs."

Ruttley said that in some cases the cost of development in space is actually economical compared with some Earth-bound trials.

"With more research being processed through the pipeline, it is faster and cheaper to get something on orbit than ever before," Ruttley said. "Biotech and biology are now turnkey operations. NASA can load your experiment up, plug it in and go."

Many experiments need very little input from astronauts on the space station, while others need some maintenance, Ruttley explained.

Microencapsulation isn't the only medical technology developed in space's strange environment. NASA discovered early on in its space missions that certain microbes become more virulent in microgravity. For example, Salmonella bacteria change their gene expression and become three to seven times more virulent in low-gravity environments. A company was able to use the data from space to create a Salmonella vaccine, which is currently being tested by the FDA.

Other companies are sending microbes to the station, developing a pneumonia vaccine and a MRSA vaccine for staph infections. Japanese scientists are studying protein-crystal growth in space. If protein is crystallized in space, it grows freely because of the microgravity

environment. Those perfect crystals are will hopefully make better treatments for a particular kind of muscular dystrophy called Duchenne's. One treatment is now being tested in animals.

"We're excited and we work hard to make sure that station is used the way it was intended for science," said Ruttley.

Provided by Inside Science News Service