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Space adds new dimension to cancer research

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When the space shuttle Discovery blasts off to the International Space Station (ISS) later today (launch scheduled Friday August 10, 2001 - 5.39 pm EDT), it will be taking with it a frozen clump of ovarian cancer cells. On the station, mission specialists will thaw them and grow them into a three-dimensional cluster that resembles the type of tumor one sees in the body, rather than into the abnormal shape on the flat bottom of a laboratory culture dish.

The researchers from theUniversity of South Florida College of Medicine and the National Aeronautics and Space Administration (NASA) hope their culture will provide a biologically more accurate model for studies of ovarian cancer development and its responsiveness to chemotherapy and antihormonal agents.

Such a three-dimensional cluster can only be grown when the cells are in free fall and so subjected to a lower apparent gravitational pull (microgravity) than when sitting in a dish on Earth. Kevin Fong, lecturer in space medicine and physiology at University College London, says this *in vitro* model could be revolutionary.

Since 1992, the project team has grown ovarian cancer cells in a tissue culture chamber, known as a rotating wall vessel (RWV) bioreactor, designed by NASA to simulate microgravity. This soup-tin sized bioreactor contains a fluid with cells in suspension. The microgravity of 10-3 - 10-4g established when it spins makes the cells continually fall yet never hit the bottom of the vessel. As a result, the cells grow in three dimensions, giving a more biologically representative *in vitro* model of a tumor *in vivo*.

"The ovarian cancer cell line we use is from a mixed lineage. When they are grown in two dimensions, you see only epithelial cells, but in three dimensions we see a wider range of cell type, resulting in a biologically more representative model of tumors as found in the body," explains Jeanne Becker, Associate Professor of Obstetrics and Gynaecology at the University of South Florida College of Medicine in Tampa.

What the team wants to learn from the experiment on the ISS is how the cells will develop when they are grown in the microgravity of the ISS - about 10-6g

They will also test the cells for markers involved in tumor development. "In particular, we will be looking at important aspects of these cells, such as cell cycle kinetics and the protein expression associated with ovarian cancer - such as p53 and ras - to see whether any changes are similar to those we have observed in the laboratory," says Becker.

Already, the team has found that tumor cells grown in the ground-based bioreactor are more drug resistant than when grown on a flat surface. For example, the same dose of taxol that kills ovarian cancer cells grown in standard *in vitro*cultures will not kill all the cancerous cells in the more complex three-dimensional model.

If the studies are successful, Becker hopes this type of culture could be a more reliable way to test new drugs and hormone therapies before they are administered to patients.

This research is part of the overall goal of the ISS, which is to establish and maintain a permanent presence in space and to provide an orbital laboratory for long-term research in biology, chemistry, physics, ecology and medicine. In addition to the ovarian cancer cell line, experiments with kidney epithelial cells, colon cancer cells and neuroendocrine cells, supplied by other investigators, are being taken to conduct experiments in the ISS during this mission.

The ISS, a co-operative venture by the US, Europe, Russia, Canada and Japan, is the largest international scientific and technological project ever undertaken. It orbits the Earth and once fully assembled will be larger than a football stadium. "It's the most exciting era since the Apollo missions," says Fong, " but not without an element of controversy."

Many scientists argue the vast expenditure being pumped into the ISS remains unjustified. The project, in many ways a successor to the Russian Mir space station, is now several years behind schedule and billions of dollars over budget. It is also argued that the experiments planned for the ISS will produce reasonable science but that overall it is not worth the money.

"Yes the science isn't cheap and yes there are practical limitations but now it's up there it should be used to the best of it's potential. The quality of the science earmarked for the ISS - and the ovarian cancer research can be included in this - is potentially some of the most important ever done, as these studies can't be done anywhere else, so it's worth paying good money to find these things out," says Fong.

"And whilst I'm never going to say the ISS is value for money, it has to be remembered that this is still at an immature stage - it's three years into a 15 year project. But they estimate in 10 years time it will be 10 times cheaper and in 20 years time it will be 100 times cheaper, so when this becomes a mature project, it is likely this will become an effective platform for science."

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