MICROENCAPSULATION OF ANTI-TUMOR DRUGS (MEPS)

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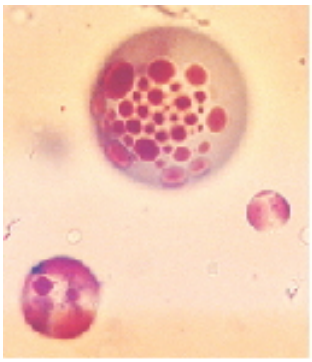
Expedition 5

Research Area Physical and Biological Sciences



Micro-balloons containing anti-tumor drugs and small amounts of radio-contrast oil were created during MEPS operations. This oil, which is traceable by radiograph, allows doctors to follow the microcapsules as they travel to the tumor. The permeable outer skin releases the drug slowly, giving the microcapsule plenty of time to reach its destination. This slow release prevents artery damage as the drug travels to its destination.

The microcapsulation electrostatic processing system (MEPS) is an automated system that is used to produce liquid-filled micro-balloons. It works through the use of microcapsules, unique capsules resembling miniature liquid-filled balloons the size of blood cells, that deliver FDA-approved anti-cancer drugs by injection into the blood-stream. The microgravity environment on ISS is vital to the development of these capsules because the station environment enables the pharmaceutical and its outer membrane to form spontaneously.

MEPS was designed with flexibility in mind. The system can process a wide range of experiments. For example, it can handle volumetric proportions of up to six chemical constituents; it can transfer liquids back and forth, at variable rates, between its six reservoirs and two main chambers; it can apply different electrical fields to the enclosed experiments; and it can be programmed to use filters or membranes of different porosity between chambers. Electrical fields charge the surface of the microcapsules, making it less recognizable as a foreign invader to the immune system.

The use of microcapsules will benefit the treatment of several diseases. For example, to eliminate daily insulin shots diabetes patients can use implanted microcapsules as treatment. A further Earth application is the microcapsules can be used as a substitution for chemotherapy. Traditional anti-cancer treatment involves large quantities of drugs that affect the entire body. The microcapsules contain a smaller dose of medication that directly targets tumors. Also, they reduce the unwanted side effects currently produced by chemotherapy.

RESULTS

MEPS experiments were conducted during Expedition 5. Eight samples were processed using various methods to mix dissimilar liquids to form micro-balloons/microcapsules. The recovered micro-balloons were analyzed for size and drug content. Additionally, studies included the effects of temperature and internal pressure on the size of the micro-balloons. Ground-based medical investigations revealed that when using these microcapsules, the growth of human prostate and lung tumors can be inhibited with only a few local injections. When anti-cancer micro-capsules are injected following cryosurgery, the combined treatment can completely destroy 1- to 2-cm-size tumors in just three weeks.

PUBLICATION(S)

Le Pivert P, Haddad RS, Aller A, Titus K, Doulat J, Renard M, Morrison DR. Ultrasound Guided, Combined Cryoablation and Microencapsulated 5-Fluorouracil, Inhibits Growth of Human Prostate Tumors in Xenogenic Mouse Model Assessed by Fluorescence Imaging. *Technology in Cancer Research and Treatment*. 3(2):135–42, 2004.

Morrison DR, Haddad RS, Ficht A. Microencapsulation of Drugs: New cancer therapies and improved drug delivery derived from microgravity research. Proceedings of the 40th Space Congress, Cape Canaveral, Fla. Apr 2003.