STUDIES ON THE EFFECTS OF MICROGRAVITY ON THE ULTRASTRUCTURE AND FUNCTIONS OF CULTURED MAMMALIAN CELLS

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The human body consists of 10^{13} cells. Understanding the mechanisms by which the cells sense and respond to microgravity is very important as the basis for space biology. The cells were originally isolated aseptically from mammalian bodies and cultured in vitro. A set of cell culture vessels has been developed to be applied to three kinds of space flight experiments.

Experiment I is to practice the cell culture technique in a space laboratory and obtain favorable growth of the cells. Aseptic handling in tryspin treatment and medium renewal will be tested. The cells, following space flight, will be returned to the ground and cultured continuously to investigate the effects of space flight on the cellular characteristics.

Experiment II is to examine the cytoskeletal structure of the cells under microgravity conditions. The cytoskeletal structure plays essential roles in the morphological construction, movements, axonal transport, and differentiation of the cells. The cells fixed during space flight will be returned and the cytoskeleton and ultrastructure observed using electron microscopy and fluorescence microscopy.

Experiment III is to study the cellular productivity of valuable substances. The waste medium harvested during space flight are returned and quantitated for the cellular products. The effects of microgravity on mammalian cells will be clarified from various aspects.

Expected Results

Cell culture is a basic method used in biology, medicine, pharmaceutics, agriculture, and biotechnology. The establishment of the cell culture technique in a space laboratory is expected to be applicable in various fields of science. It will be of particular use to help clarify some of the basic phenomena concerning living things in space, which is difficult to elucidate using entire animals or plants. For example, it will be determined in a simplified experimental system whether the bone metabolic alterations occurring in astronauts reflect the direct action of microgravity on bones. In addition, some of the cultured cells produce valuable autacoids and physiologically important bioactive substances which can be utilized pharmaceutically. It is possible that highly purified substances can be produced using the continuous free-flow electrophoresis device in a space laboratory. This experiment will hopefully give definitive results concerning the effectiveness of separations conducted in the microgravity environment.