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ADVANCES OF SPACE LIFE SCIENCE PROJECTS ON CHINESE TIANZHOU-1

Abstract

The Tianzhou-1 is a Chinese automated cargo spacecraft developed from China's first prototype space station Tiangong-1 to resupply its future modular space station. Tianzhou-1 is kitted out with a range of science experiments and Space Life science research projects were performed. The influence of microgravity on mammalian cells including the development of different embryonic stem cells were tested, effects of microgravity environment on osteoblast activities, 3-hydroxybutyric acid as a new potential medicine against osteoporosis for astronauts in space was studied. Despite a great number of studies analyzing the effects of microgravity on stem cell proliferation and differentiation, few of them has focused on what happens in such processes while the cells are in orbit. In Tianzhou-1, effect of space microgravity on the morphology, proliferation, and differentiation of mouse embryonic stem cells was evaluated. In order to explore the effect of microgravity on the proliferation of liver stem cells and provide a basis for the establishment of the expanded training system of liver stem cells in the future, the influence of the real microgravity in space on three-dimensional culture and proliferation of the liver stem-like cell line WB-F344 was carried on the Tianzhou-1 spacecraft and the effect of microgravity on the proliferation of WB-F344 was observed in space during the three-dimensional culture. 3-hydroxybutyric acid was found to have a promoting effect on bone formation, and the effect was significant under the simulated microgravity. The number and morphological changes of osteoblasts were observed under the condition of co-culture containing or not containing 3-hydroxybutyric acid. Furthermore, the healthy growth of these cells in space was analyzed, and the therapeutic effect on osteoporosis was observed at the cellular level. The real-time changes of morphology and proliferation of osteocyte MLO-Y4 and osteoblast GFP-labelled MC3T3-E1 under the microgravity environment were investigated. This research was designed to reveal the cellular mechanism of space bone loss and supply further evidences for the verification and evaluation of ground-based simulated microgravity experiment results of bone cells. The casein kinase 2 interacting protein-1 is a previously identified negative regulator of osteoblast activity and it was found that the aberrant elevated CKIP-1 expression in osteoblasts could directly inhibit bone formation to contribute to the bone formation reduction during osteoporosis. During the Tianzhou 1 mission, the effect of osteoblastic reduced CKIP-1 expression on the differentiation function in microgravity was studied.