IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Science Results from Ground Based Research (4)

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DIFFERENTIAL CELLULAR RESPONSES AND PHYSIOLOGICAL EFFECTS OF CANCER CELLS TO SIMULATED MICROGRAVITY

Abstract

Simulated microgravity allows you to explore the molecular and cellular mechanisms of the biological effects on cellular stress and the transformation of normal and tumor cells with a change in gravity. We investigated the effects of simulated microgravity on Jurkat cells and their multidrug-resistant subline, Jurkat/A4 cell using a Desktop random positioning machine (RPM). The viability of Jurkat/A4 cells decreased after simulated microgravity in contrast with the Jurkat cells. At the same time, the viability between the experimental Jurkat cells and control Jurkat cells was not significantly different. Of note, Jurkat cells appeared as less susceptible to apoptosis than their clone Jurkat/A4 cells, whereas cell-cycle analysis showed that the percentage of Jurkat/A4 cells in the S-phase was increased after 72 and 96 h of RPM-simulated microgravity relative to their static counterparts. Western blot analysis showed contrasting expression of cyclin B1, D1, E and A in Jurkat cells under microgravity conditions. The expression of cyclins in Jurkat/A4 cells also changed. Furthermore, expression of cyclin A was decreased in the Jurkat/A4 cells under microgravity conditions. Thus, we concluded that Jurkat/A4 cells are more sensitive to RPM-simulated microgravity as compared with the parental Jurkat cell line. Exposure of megakaryoblastic cells (MEG-01) to RPM-simulated microgravity for up to one week significantly increased cellular apoptosis compared to the static group. Flow cytometry analysis of the cell cycle revealed a significant increase in the percentage of cells in the G0/G1 phase after one week of RPM-exposure compared to the static group. Additionally, after one week, a difference in morphology was detected between the cells of the static group and the cells exposed to microgravity conditions. We examined of cyclin D, B, E and A cyclin expression in cells using western blot analysis and flow cytometry. The cyclin levels in MEG-01 cells under RPM-modeled microgravity also changed, in particular, cyclin E expression was higher. The expression of the CD33 surface marker was significantly decreased after a one week of microgravity exposure compared to the 1 g-control. We, therefore, concluded that effects of weightlessness on apoptosis and cell proliferation depend on conditions and different cell types. Further application of biotechnology facilitated with the use of various cells and tissue cultures will allow a better assessment of the adverse effects of gravity on human health and play a role in the preparation of future space missions.