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EFFECTS OF DIFFERENT MODALITIES OF SIMULATED MICROGRAVITY ON EMBRYONIC DEVELOPMENT OF ZEBRAFISH, DANIO RERIO

Abstract

Zebrafish have become a widely used model vertebrates for research in molecular and developmental biology. Recently this species has been used for studies of the effects of microgravity on fundamental biological processes. Zebrafish being small in size, developing rapidly to sexual maturity and producing relatively large numbers of transparent embryos are ideal for space research. Understanding the developmental processes of such model organisms under conditions of reduced gravity is important not only for fundamental biological studies but also for the development and use of bioregenerative life support systems. Given the limited opportunities for space flights, ground based experiments provide an important means for providing initial data regarding the effects of microgravity and guiding future work in space. Currently there are only four commonly used methods to simulate microgravity for periods sufficient to investigate developmental processes; the rotating wall vessel (RWV), 2- and 3-D clinostats and the random positioning machine (RPM). To date most research simulating microgravity has utilized the rotating wall vessel and focused on cell cultures, the results suggesting changes in the rates of cellular proliferation and differentiation. In this study we aimed to test whether these effects are manifested in whole organisms. Preliminary work revealed that embryos reared in the RWV beyond early somitogenesis (3-4 somite stage) reached key developmental staging points more rapidly than fish raised within a non-rotating vessel. However, by late somitogenesis (21 somite stage) both groups of embryos were again roughly synchronized in their developmental staging. Recently we have developed protocols for the use of zebrafish embryos in 2- and 3-D clinostats, as well as for the newly developed RPM. Embryos raised under conditions of simulated microgravity using the RPM showed similar trends of accelerated embryonic development from early through late somitogenesis. Investigations of the effects of 2- and 3-D clinostat simulations of microgravity conditions are currently ongoing. Our results will allow for the first time a comparison of the effects of different simulations of microgravity on whole-embryo development.Together, our data will provide insights into how zebrafish may develop when eventually flown in space thus permitting better formulation of experiments to test the mechanisms by which microgravity affects ontogeny of this model organism.