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APPLICATIONS OF MICROGRAVITY TECHNOLOGY FOR STUDYING CELLULAR DEVELOPMENT AND THREE DIMENSIONAL TISSUE FORMATIONS

Abstract

With the growth of space life sciences and biotechnology, the technique of tissue and cell culture under microgravity environment has been becoming a new research filed. Previous studies have demonstrated a dynamic simulated microgravity (SMG) culture system as a "stimulatory" environment for the proliferation of cells and formation of three-dimensional (3-D) tissue. In our recent research (published in PLoS ONE, 2011), the NASA-approved rotary bioreactor (RCCS), a cell culture system designed to create a microgravity environment, was employed to investigate the proliferation and differentiation of human epidermal stem cells (hEpSCs). Our results indicated that a dynamic simulated microgravity produced by NASA-approved rotary bioreactor can support the proliferation of hEpSCs and provide a strategy to form 3D epidermis-like structure. In our present study, we also investigated the effect of microgravity environment on the early development of embryonic stem cells in vitro. Mouse embryonic stem (mES) cells were induced to form embryoid bodies (EBs) which were used as a differentiation model to investigate the proliferation and differentiation of mES under simulated microgravity. Our data showed that RCCS predominantly facilitates the efficiency, yied and uniformity of EBs. In addition, RCCS promotes the early differentiation of mES compared with that in static condition. Real-time PCR and Western blot analysis indicated that RCCS enhances mesendodermal formation and increases mesoderm and endoderm activities in mESCs. Conversely, RCCS suppresses neuroectodermal differentiation. Surprisingly, we showed that RCCS can long-term activate Wnt/-catenin signaling pathway during mESc differentiation. In conclusion, our studies suggest that the microgravity may have an effect on cell fate determination and three dimensional tissue growth. (Supported by National Key Basic Research Program of China grand (2011CB710905), and Strategic Priority Research Program of the Chinese Academy of Sciences Grant (XDA04020202-20 and XDA01010202).