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OBSERVATION OF PRIMARY CILIA-DEPENDENT DEPOLYMERIZATION OF MICROTUBULES INDUCED BY SIMULATED-MICROGRAVITY

Abstract

Along with the growing number of flights in space, more and more astronauts will be exposed to microgravity. It has been observed that microgravity could induce changes on the cellular cytoskeleton including polymerization, depolymerization, as well as the array and direction of actin filaments or microtubules in different types of cells. As a critical target of microgravity, the primary cilium of osteoblasts were observed to be abrogated in microgravity conditions in our previous work. However, the cytoskeletal changes of primary cilia which based on microtubules structurally have not been reported. Here, we further investigated the intrinsic connections between cytoskeleton changes and primary cilia. After the rat calvarial osteoblasts (ROBs) were exposed to simulated microgravity produced by a random positioning machine, the changes of cytoplasmic microtubules in the basal feet of primary cilia in microgravity conditions were analyzed by a confocal microscope. It was found that in addition to the depolymerization of microtubule network of the ROBs, the microtubules emanating from the primary cilium basal body was also disrupted significantly and its number decreased dramatically in microgravity conditions. Moreover, the depolymerization of microtubules induced by simulated-microgravity was inhibited by the treatment of chloral hydrate (CH) which could prevent primary cilia formation, suggesting that the depolymerization of microtubules induced by simulated-microgravity correlated with the abrogation of primary cilia. On the other hand, stabilizing microtubules with Docetaxel Trihydrate (DOC) prevented the osteogenic inhibition of the ROBs induced by simulated-microgravity. Taken together, these data suggest that primary cilia-dependent depolymerization of microtubules is responsible for the inhibition of osteogenesis induced by microgravity. Our study provides a new perspective regarding the mechanism of microgravity-induced bone loss, supporting the previously established role of primary cilia as a sensor of microgravity.