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PRIMARY CILIA OF OSTEOBLASTS ARE CRITICAL TARGET OF MICROGRAVITY

Abstract

It is well documented that the microgravity in space causes serious bone loss and lead to the osteopenia of astronauts. These physiological changes have also been validated by human and animal studies and modeled in cell-based analogs. However, the underlying mechanisms are still not clear. Primary cilium, a solitary organelle that emanates from the surface of most mammalian cells, has been reported as a mechanosensor or chemosensor, suggesting that the primary cilium may be a critical target of microgravity stimuli and plays a key role in bone loss induced by microgravity. In here, the rat calvarial osteoblasts were exposed to simulated microgravity produced by a random positioning machine, and the changes of primary cilia and cytoplasmic microtubules induced by microgravity were analyzed. It was found that along with the repression of the differentiation, maturation and mineralization, the primary cilia of osteoblasts were shrank gradually and disappeared almost completely in microgravity condition. Moreover, the microtubules of osteoblasts were depolymerized by disruption of microtubules emanating from the ciliary base. In addition, the repression of the osteoblastic differentiation, maturation and mineralization induced by microgravity were effectively offset by stabilization of primary cilia with chemical treatment such as cytochalasin D. These results indicate that the abrogation of primary cilia and cilia-dependent depolymerization of microtubule are responsible for the inhibition of osteogenesis induced by microgravity. Reconstruction of primary cilia may become a potential strategy against bone loss induced by microgravity.