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Induction mechanism of neural differentiation of human bone marrow mesenchymal stem cells by electromagnetic field

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Electromagnetic field (EMF) is a well-known mechanical stimulation that induces neural differentiation. This is an affordable and effective way to treat neurodegenerative disease. Even though its function is distinctive, the underlying cellular mechanism of neural differentiation remains unclear. Human bone marrow-derived mesenchymal stem cells (BM-MSCs) which exposed to 50 Hz, 1 mT for 12 days were differentiated into neural cells. Besides differentially expressed proteins, especially ferritin light chain (FLC), were verified using 2-DE analysis. FLC is an important element in controlling iron ion homeostasis and is abundant in the specific region of central nervous system (CNS). After exposed to EMF, intracellular free Zn ion concentration was observed to decrease as well as block activity of MRE transcription binding factor 1 (MTF1). Down-regulated MTF1 had an effect on the synthesis of MT3 and differentiation of hBM-MSCs to neural cells in EMF compared with control. EMF also induced activation of downstream candidates of MT2 in novel neural differentiation mechanism. From astrocyte, MT3 is secreted into neuron. The level of MT3 changed, in response to EMF, allowed the adaptation of binding affinity of dihydropyrimidinase related protein 2 (DRP2). DRP2 is one of well-known neural growth factors. This study demonstrates that EMF triggers up-regulation of FLC in BM-MSCs. Up-regulated FLC has positive effects on the differentiation of BM-MSCs to neural cells compared with control group. EMF also induces activation of downstream candidates of FLC in novel neural differentiation mechanism. Intracellular iron level was down-regulated and ferritin heavy chain (FHC), iron regulatory protein-1 (IRP-1) and cofilin were up-regulated in EMF exposed group. Up-regulated cofilin triggers actin filament reorganization in neural morphogenesis.

Biography

Chan-Wha Kim has completed his PhD and Postdoctoral studies from MIT. He is the Professor at the Korea University located in Seoul, Korea. He is a member of the Korean Acedemy of Science and Technology. He has published more than 150 papers in reputed journals and has been serving as an Editorial Board Member of Proteomics.

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