

# The Clustering of Growth Factor and Cytokine Factor Receptors Was Induced by 50 Hz Magnetic Field and Blocked by Noise Magnetic Field

SUN Wenjun, FU Yiti, JIANG Huai, and LU Deqiang.

Bioelectromagnetics Lab., Zhejiang University School of Medicine. Hangzhou 310031, China.

Correspondence should be addressed to SUN Wenjun ( e-mail: sunwj@zju.edu.cn)

**Abstract** To study the possible effects of 50Hz magnetic field (MF) exposure on clustering of cell surface receptors, explore the mechanism of signal transduction of ELF-MF and confirm whether or not the noise magnetic fields ( MF ) interfere these effects induced by 50 Hz MF. Chinese Hamster Lung (CHL) cells were respectively exposed to 50Hz MF, noise MF with 0.4 mT, and combined MF which was superposition of 50 Hz MF with noise MF for different exposure durations (5, 15 and 30 min). Cells treated with 100ng/ml epidermal growth factor (EGF) or 10ng/ml tumor necrosis factor (TNF) for 15 min served as positive control. The clustering of EGF and TNF receptor was analyzed with confocal microscope. The results showed that, like the EGF and TNF, 50 Hz MF at 0.4 mT could obviously induce the clustering of cell surface receptors after exposure for 5 min, while the noise MF alone with the same intensity did not induce receptor clustering. When superposed of noise MF with the same intensity, the receptor clustering induced by 50Hz MF was inhibited. It suggested that the membrane receptors would be the target sites where MF interacts with cell, and the noise MF could interfere these effects.

**Keywords:** 50 Hz magnetic fields; receptor; clustering; noise magnetic field; interference

That the electricity was widely used in our society made the extremely low frequency electromagnetic fields (ELF-EMF) in environment more and more high. Evidence is accumulating that exposure to ELF-EMF may produce a lot of biological effects. Especially, some reports showed that ELF-EMF such as those from electric power transmission and distribution lines have been associated with increased risk childhood leukemia, cancer of the nervous system, lymphomas and breast cancer<sup>[1-6]</sup>. However, the mechanism of ELF-EMF biological effects is still unclear. Our previous study showed that 50 Hz magnetic field (MF) with 0.4 mT could phosphorylate and activate the stress-activated protein kinase (SAPK) and P38 mitogen-activated protein (MAP) kinase (P38 MAPK)<sup>[7, 8]</sup>. Kie et al.<sup>[9]</sup> also showed that ELF-EMF induced the mitogen-activated protein (MAP) kinase (Erk1/2) activity. These are evidences that ELF-MF exposure may activate signal transduction pathways. Yet, where and how the EMF signal transfers into biological signal in cells is unknown. Since many low-energy electromagnetic fields have little energy to directly traverse the membrane, it is possible that they may modify the existing signal transduction procession in cell membrane, thus producing both transduction and biochemical amplification of the effects of the field itself<sup>[10]</sup>. In the present study, we explored if exposure cells to 50Hz MF can induce clustering of cell surface receptors like their ligands, and also investigate whether noise MF