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Disruption of Cancer Cell Proliferation by Magnetic Field

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Abstract : Static magnetic fields (SMF) are widely used in several medical applications, especially in diagnosis of tumors. However, biological effects of the SMFs on modulating cell physiology through the Lorentz force, which is highly frequency and magnitude dependent, remain to be elucidated. Specific patterns from SMFs of static MF, delivered by means of Halbach array magnets with a gradient increment of 6.857mT/mm from center to border, were found to have profound inhibitory effect on the growth rate of human cell line derived from Nasopharyngeal carcinoma patients. The SMFs, which were shown to be noncontact, selectively impact rapid dividing cells while quiescent cells stay intact. The phenomenon acts in two modes: the arrest of cell proliferation in the G2/M phase and destruction of cell mitosis in cell division. First mode is manifested by impacting the proper formation of mitotic spindle, whereas the second results in disintegration of the cancer cell. Both modes are demonstrated when SMF was applied for 24 hours to cancer cells, the results revealed that metaphase arrest during mitosis due to activation of DNA damage response (DDR), resulting in high expression of ATM-NBS1-CHEK signaling pathways and higher G2/M phase ratio compared with control group. Here, experimental data suggest that the SMFs cause activation of cell cycle checkpoints, which implies the MFs as a potential therapeutic modality as a sensitizer for radiotherapy or chemotherapy.

Keywords : static magnetic field, DNA damage response, Halbach array, magnetic therapy
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