Nanosecond pulsed electric fields depolarize transmembrane potential via voltage-gated K^+, Ca^{2+} and TRPM8 channels in U87 glioblastoma cells

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Title

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Authors

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Abstract

Nanosecond pulsed electric fields (nsPEFs) have a variety of applications in the biomedical and biotechnology industries. Cancer treatment has been at the forefront of investigations thus far as nsPEFs permeabilize cellular and intracellular membranes leading to apoptosis and necrosis. nsPEFs may also influence ion channel gating and have the potential to modulate cell physiology without poration of the membrane. This phenomenon was explored using live cell imaging and a sensitive fluorescent probe of transmembrane voltage in the human glioblastoma cell line, U87 MG, known to express a number of voltage-gated ion channels. The specific ion channels involved in the nsPEF response were screened using a membrane potential imaging approach and a combination of pharmacological antagonists and ion substitutions. It was found that a single 10ns pulsed electric field of 34 kV/cm depolarizes the transmembrane potential of cells by acting on specific voltage-sensitive ion channels; namely the voltage and $Ca2^+$ gated BK potassium channel, L- and T-type calcium channels, and the TRPM8 transient receptor potential channel.

Keywords