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Collective Effects of Nanosecond Pulsed Electric Fields on Cells Organized in a Monolayer

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Basic research on the underlying mechanisms of pulsed electric field effects of sub-microsecond duration on mammalian cells has mostly focused on the study of individual cells in suspension. However, for cells that are organized in a tissue, connections and communication between cells are crucial. Accordingly, we investigated besides intracellular effects also extracellular effects and in particular the response on tight junctions and cell-cell communication and how both affect the development of cells in a tissue, such as their potential to metastasize. Distinct effects could be found that are primarily caused by a transient disassembly of respective membrane proteins that are only compensated by repair mechanisms over the course of one hour [1,2,3]. Conversely, these changes have an immediate effect on intracellular biomolecular pathways, elastic properties of cells and on the permeability of tissues. Some of these effects can be enhanced by combining the treatment with pulsed electric fields and exposures to non-thermal plasmas. Overall this allows for new possibilities for tumour treatment and potentially also tissue regeneration.

[1] F. Shi et al., IEEE Trans. Biomed. Eng. (2019) in print. doi:10.1109/TBME.2018.2882299

[2] A. Steuer et al., PloS one 13 (2018) e0204916. doi:10.1371/journal.pone.0204916

[3] A. Steuer et al., European Biophysics J. 46 (2017) 567. doi:10.1007/s00249-017-1205-y

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