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7th Global Neurologists Annual Meeting on

Neuro Surgery and Interventional Radiology

August 22-24, 2016   Vienna, Austria

Computationally investigating Tumor Treating Fields (TTFields) using human phantoms

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Tumor Treating Fields (TTFields) are a physical modality for treating solid tumors. TTFields are approved for the treatment of glioblastoma multiforme (GBM), the most common and agressive brain tumor in humans. TTFields are alternating electric fields in the intermediate frequency range (100-300 kHz) with low intensities (1-3 V/cm), that are applied non-invasively via capacitively coupled transducers placed directly on the skin close to the tumor. TTFields exert an anti-mitotic effect on cells. This effect is frequency-dependent with the maximal effect achieved at different frequencies for different cell lines. Arrest of proliferation also increases with increasing field intensity leading to complete arrest for glioma cells at 2.25 V/cm. TTFields exert their antimitotic effect by disrupting the formation of the mitotic spindle. Preclinical studies show that treatment efficacy is related to the field intensity and field direction, which are not easily measured in patients. Therefore computational models are a valuable tool for understanding how TTFields distribute within the body. These computational models are based on physical phantoms derived from MRI data that are segmented into heterogenous tissue types with distinctive dielectric properties which influence the electric field distribution. Also anisotropy in the tissues can be accounted for by processing a Diffusion Tensor Imaging dataset. These models can be used to perform retrospective analysis of reported treatment outcomes, but also prospectively for personalized treatment planing and investigating alternative transducer array placements.

Biography

C Wenger received her degrees, Dr.sci. and M.Sc., from the Faculty of Mathematics of the Technical Univeristy of Vienna in 2012 and 2008 respectively. She is currently working as a postdoctoral researcher at the Institute of Biophysics and Biomedical Engineering at the University of Lisbon. With her reserach group, she publishes pioneering computational studies on the modeling of TTFields. Realistic human head models are used to study treatment efficacy in patients and single cell models are employed to examine mechanisms of action of TTFields. She is a full member of the Society for Neurooncology

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Notes:

J Neurol Neurophysiol
ISSN: 2155-9562 JNN, an open access journal

Neurosurgery and Neuroradiology 2016
August 22-24, 2016

Volume 7, Issue 4(Suppl)

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