Optimization of transient temperature field distribution of biological cells under laser irradiation

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Abstract

When the near-infrared laser irradiates biological target cells, photothermal effect is a major factor in the interaction between laser and biological cells, and the temperature is an important symbol to measure the effect of the laser irradiation on biological target cells. Due to the research of photothermal effect's generation, transmission and mechanism is not very clear, temperature calibration of laser irradiation on target cells is not very definite in this study. This paper uses the finite element software ANSYS Workbench to simulate the numerical model of laser irradiation on target cells, compare with the temperature value of extracellular fluid measured in the Patch clamp air electrode experiment, and do the corresponding optimizations work. We make a numerical simulation analysis in the case of ignoring the cell membrane and get the result which is consistent with theoretical ideal value. In the case of distinguishing cell membrane and cell SAP, we conduct numerical simulation, fit out the transient equation of temperature rise and drop consistent with the patch clamp experiment and further optimize the transient temperature distribution of biological cells under laser irradiation which has an important role in the research of clinical applications of laser.

Keywords: Photothermal effect, ANSYS Workbench, Patch clamp, Transient temperature distribution