Christine Schmeitz
Systems Immunology, Helmholtz Centre for Infection Research
e-mail: Christine.Schmeitz@helmholtz-hzi.de

Michael Meyer-Hermann
Systems Immunology, Helmholtz Centre for Infection Research
e-mail: Michael.Meyer-Hermann@helmholtz-hzi.de

Modeling approach to T cell electrophysiology

An effective immune response to invading pathogenic microorganisms requires the regulated interplay of T-lymphocytes and antigen-presenting cells (APC) facilitated by the support of various cytokines. The activation of T helper cells requires the recognition of antigen, which is bound to major histocompatibility complex molecules, type class II, on the APC. For the purpose of activation the T cell receptor (TCR), assisted by coreceptors including CD4, interacts with the bound antigen and builds up the so called immunological synapse. These complex interactions imply sophisticated signaling pathways in the lymphocyte cells and implicates a network of ion channels in T cells for managing signals.

With regard to the complexity of the signaling pathways and corresponding ion fluxes through the T cell membrane, a mathematical modeling approach to T cell electrophysiology, based on experimental data of electrophysiological measurements, is needed for understanding and illustrating this functional network.Technically, the background of the projected simulation of T cell electrophysiology is based on mathematical modeling of the electrophysiology of the pancreatic beta cell [1]. The T cell model is based on single protein conductance data and, in a first step, is focussed on the electrophysiology of a resting T helper cell. In a second step, the simulation of the resting T lymphocyte will be adapted to the activated T cell state. Based on this simulation it is planned to study the effect of inhibiting and exciting drugs onto T cell activation on the level of calcium dynamics.

References

[1] Meyer-Hermann, Michael E. *The Electrophysiology of the ß-Cell Based on Single Transmembrane Protein Characteristics*. Biophysical Journal 93, 2007: 2952-2968