

THE POTENTIAL PROFILE ACROSS THE NEURON MEMBRANE FOR RESTING AND ACTION STATES

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OBJECTIVES

To determine the potential profile for a model of neuron membrane for two physiological states: resting and action states.

METHODS

The space-dependent electric potential equations were determined by solution of non-linear Poisson-Boltzmann equation. It considered a neuron membrane model that takes into account the charge densities due to charges dissolved in an electrolytic solution and fixed on both glycocalyx and cytoplasmic proteins. It was assumed that on both sides of the membrane the charges are homogeneously distributed. Therefore, the potential was dependent only z -coordinate. The second order solution of equations into the glycocalyx and cytoplasmic regions was performed by means of the Runge-Kutta method. Numerical values from literature were applied in the problem to simulate resting and action conditions of the neuron. The glycocalyx surface density has been calculated from the data obtained in electrophoretic experiments, using the Helmholtz-Smoluchowski equation. The inner surface charge density of lipidic bilayer was derived from a known lipid composition of neuron membrane. The spatial charge density of the glycocalyx was estimated from the surface charge density, since it can be considered to be almost constant in the z direction.

RESULTS

Results showing the features of the potential profile along the outer electrolytic region are similar for both resting and action states. However, the potential fall along glycocalyx at action state is lower than at resting.

CONCLUSIONS

We conclude that the effects on the potential profile due to surface lipidic bilayer charge and contiguous electric double layers are more relevant than those provoked by fixed charges distributed along the cell cytoplasm.