Structural and functional properties of mutant NMDA synaptic receptors

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Abstract

In the development of various kinds of neurodegenerative diseases, as well as after exposure to ionizing radiation, a number of disorders are associated with changes in the synaptic transmission. It is suggested that these effects are of a genetic nature and are associated with the occurrence of mutations in genes encoding key proteins. The aim of this work was to develop a computational approach capable to establish a link between mutations in a genetic structures and high-level observable properties of neural tissue. In the course of the work, molecular-dynamic modeling of NMDA receptor ion channel gating was carried out. The receptor was constructed from mutant forms of proteins. The analysis of the resulting configurations made it possible to determine the change in the conductivity of the ion channels, and the obtained data were implemented in the structure of model neural network of hippocampus. As a result, it was possible to identify the effect of single and double point mutations in the genes encoding protein subunits of NMDA receptors on the generation of theta- and gamma- rhythms by the neural network. Obtained results can be applied for the analysis and evaluation of possible cognitive impairments arising from the action of radiation and other negative factors.