Dynamical model of neuronal activity and ion channel dynamics over the aortic wall

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Abstract

The transmission of nerve signals is closely related to the incidence of aortic dis- eases. However, due to the multilayer and complex structure of the vascular wall, the mechanism of ion channel dynamics of aortic diseases has not been under- standing well. Here, we demonstrate that the ion channel dynamic behavior on neural information can be simulated by a stochastic differential equation (SDEs) based on discrete Markov chains. The continuous approximation model is formu- lated and solved numerically. It can analyze the variation of voltage with time, and the value of voltage is related to the trajectory of past voltage. By chang- ing ion channel dynamics, our model can replicate in vitro and downward spike adaptations in neocortical pyramidal cells and cap neurons. Moreover, it also produces an inter-peak power-law distribution with a longer first peak latency and higher peak-to-peak variability. The results obtained in close agreement with the statistical data on ion channels and potential actions. Our research extends the knowledge into the biological mechanisms induced by ion channels and neural information networks.

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