Abstract View

CORTICAL I_H PLAYS A ROLE IN THE GENERATION OF PAROXYSMAL ACTIVITIES.

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Slow neocortical paroxysmal activities are characterized by increased amplitude of depolarizing and hyperpolarizing envelopes in some neocortical neurons, compared to slow sleep oscillations (Steriade et al., 1998). Sudden depolarization leading to the next paroxysmal cycle starts when the majority of cortical neurons are hyperpolarized. At least two factors play a critical role in the generation of hyperpolarizing potentials. These are the Ca^{2+}-dependent K^+ current and the disfacilitation that result from the temporal absence of synaptic activities in the network. Here, in experiments and computational models we investigated the possible role of hyperpolarization-activated depolarizing current (I_h) of cortical neurons in the generation of paroxysmal onsets. In vivo intracellular recordings with Cs^+ filled pipettes suggest that K^+ currents are significantly implicated in the generation of hyperpolarizing potentials during seizures. Earlier data showed an increase in $[K^+]_o$ during paroxysmal activities. Such conditions are favorable for the positive shift in the reversal potential of K^+ currents. In paroxysmal neocortex, about 10% of neurons showed repolarizing potentials originating from hyperpolarizations associated with positive depth EEG-waves of spike-wave complexes. The onset of these repolarizing potentials corresponds to the maximal $[K^+]_o$ at each paroxysmal cycle. Intracellular Cs^+ blocked the repolarizing potentials suggesting that I_h may mediate them. Using computational model, we found that the increase in $[K^+]_o$ produces the positive shift in the reversal potential for K^+ that results in significant activation of cortical I_h and that was the primary factor in the initiation of 2-3 Hz activity in the modeled cortical network.
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