Abstract View

A MODEL OF RETICULAR THALAMIC SPINDLE OSCILLATIONS MEDIATED BY $GABA_A$ DEPOLARIZATION.

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Intracellular recordings from reticular thalamic (RE) neurons in vivo suggest that in RE cells hyperpolarized below the Cl^- reversal potential, reversed inhibitory postsynaptic potentials (IPSPs) can directly trigger a low-threshold Ca^{2+} spike. In a large-scale, two-dimensional (2D) network model of the RE nucleus with membrane potentials lower than the Cl^- reversal potential, $GABA_A$-mediated synaptic excitation led to propagating patterns of spike-burst activity, which could be transformed into self-sustained oscillations (Nature Neurosci. 2:168, 1999). However, the mean membrane potential of the majority of RE cells in vivo is more positive than the Cl^- reversal potential. Here we investigate whether the patterns of RE excitation can propagate or sustain in the 2D RE network model if only a small fraction of RE cells is hyperpolarized below the $GABA_A$ reversal potential. Resting potentials of RE cells were randomly set between -65 and -75 mV. Self-sustained oscillations were found in the 2D RE network when only 25% of RE cells were hyperpolarized below the Cl^- reversal potential. Activity patterns appeared in the form of spiral waves moving irregularly over the network domain. The size of these patterns decreased when the fraction of cells depolarized above -70 mV increased. The average membrane potential exhibited recurring periods of oscillations in the frequency range 10-15 Hz with duration that depended on network size and synaptic and intrinsic parameters of RE cells. Thus, this model predicts that $GABA_A$-mediated excitation can robustly generate sequences of spindle-like oscillations in the isolated RE nucleus.

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