Abstract View

GENERATION OF 6-14 HZ BURST DISCHARGES IN MODELS OF THE THALAMIC RETICULAR NUCLEUS INCORPORATING SYNAPTIC AND ELECTRICAL COUPLING

A.R.Houweling; M.Bazhenov; T.J.Sejnowski*

Salk Inst., La Jolla, CA, USA

The reticular (RE) nucleus of the thalamus is thought to be the site of sleep spindle initiation. Previous models of spindle oscillations in the isolated RE nucleus were based on the ability of RE cells to generate low-threshold rebound burst discharges in response to hyperpolarizing GABAergic synaptic currents. These models require a relatively hyperpolarized GABA-A reversal potential of around -80 mV. However, the chloride reversal potential in RE cells was recently found to be more depolarized around -70 mV, which does not support strong rebound bursting. Here we examined the dynamics of 1-D networks of Hodgkin-Huxley-type RE cells that have local synaptic connectivity and RE cells hyperpolarized below the GABA-A reversal potential. We found that stimulation of a few RE cells evoked depolarizing GABAergic postsynaptic potentials in neighboring RE cells that could lead to single full-blown low-threshold bursts. These burst discharges propagated in a novel, saltatory manner skipping groups of RE cells at a frequency of 10-15 Hz. The exact frequency depended on the resting membrane potential, the strength of the low-threshold (T-) current and GABA-A synaptic conductance. We also investigated 1-D networks with both synaptic and electrical coupling. With strong electrical coupling two modes of propagation were observed depending on the parameters. The first mode was similar to that of the model without gap junctions, consisting of locally synchronized burst discharges that propagated at 11-14 Hz. The second mode consisted of a local, gap-junction-mediated propagation of burst discharges that skipped groups of RE cells and repeated at 6-8 Hz. These results suggest that GABA-A-mediated excitation in the RE nucleus can robustly initiate sequences of sleep spindle oscillations.

Support Contributed By: NIH

Citation: A.R. Houweling, M. Bazhenov, T.J. Sejnowski. GENERATION OF 6-14 HZ BURST DISCHARGES IN MODELS OF THE THALAMIC RETICULAR NUCLEUS INCORPORATING SYNAPTIC AND ELECTRICAL COUPLING Program No. 196.5. 2004 Abstract Viewer/Itinerary Planner. Washington, DC: Society for Neuroscience, 2004. Online.