Abstract View

MODEL OF SLOW-WAVE SLEEP AND ITS TRANSITION TO ACTIVATED STATES IN THALAMOCORTICAL NETWORK.

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In non-anesthetized cats slow-wave sleep (SWS) is composed of sequences of silent (down) and active (up) states; the down states are absent during REM sleep and wake. SWS oscillations (< 1 Hz) and their transformation to the active awake state were investigated with computational models of the thalamocortical system. The summation of the miniature EPSPs during depth-positive (silent) phase of an oscillation could activate the persistent sodium current and depolarize the membrane of cortical pyramidal (PY) cells sufficiently for spike generation. Progressive depression of the excitatory interconnections and activation of Ca^{2+} dependent K^+ current led to termination of the 20-25 Hz activity after 500-1000 ms. Including thalamocortical (TC) and thalamic reticular (RE) neurons to the model slightly increased the frequency of SWS like oscillation and introduced waning spindle sequences. To model the effects of ACh increase, which lead to activated states, the K^+ leak current in PY and TC cells and PY-PY and TC-RE-TC synaptic conductances were reduced. These changes eliminated the hyperpolarizing phases and transformed the cortical network to the tonic firing at frequency 15-20 Hz. TC cells displayed IPSPs originating from single spikes in RE neurons and discharged spontaneously at very low rates. Afferent volleys randomly applied to TC neurons evoked firing that was reflected in the cortex. Thus, this model describes the essential features of SWS and activated states of thalamocortical system as well as the transition between them.

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