S5-P18

Environmental, Activity-dependent Modulation of Theta Rhythm During REM Sleep by its Selective Deprivation and Subsequent rebound

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The work is aimed at experimental testing of the possibility of an activity-dependent increase in power and representation of theta rhythm (4-8Hz) in REM sleep episodes. Polysomnography was performed in mature male rat (n=20) by means of electroencephalogram, electrohippocampogram, electrooculogram, electromyogram (EEG)/EHpG/EOG/EMG) leads using "Spike4" software (Cambridge Electronic Design) and was combined with video behavior monitoring. Recordings were repeated three times: baseline, selective REM sleep deprivation, and post-deprivation recovery sleep during daylight hours (08:00 am–06:00 pm). 8 electrodes were implanted by neurosurgical interventions using general anesthesia by inhalation of oxygen and isoflurane (1-3%) mixture. Interruption of REM sleep episodes was implemented by auditory stimulus application (natural alarm rat squeaking) of different intensities (50-60 dB). For arousal estimation the latency and desynchronization of total power of EEG and EHpG theta rhythm after stimulus application were measured. Total spectral power of theta band was determined for ten 5-second epochs. Theta/delta ratio (T-ratio) was calculated. Statistical analysis was realized by use of ANOVA method. Averaged total spectral power of EEG and EHpG theta rhythm during post-deprivation recovery sleep was gradually increased within REM sleep episodes elevated by frequency and duration in comparison with baseline recordings. The theta/delta ratio was also enhanced in EEG during post-deprivation sleep. The selective interruption of REM sleep episodes can provoke explorative behavior and modulation of synaptic plasticity in neocortex-hippocampus networks associated with REM sleep rebound during post-deprivation recovery. Theta rhythm enhancement may reflect intensification of spatial-temporal and emotional memory formation in REM sleep episodes during post-deprivation recovery.