Sleep spindle

Sleep spindles are sudden bursts of oscillatory brain activity generated in the reticular nucleus of the thalamus that occur during stage 2 of light sleep. These brainwaves are called sleep spindles because of how they look when printed out on an EEG reading.

Sleep spindles constitute an EEG hallmark of NREM sleep.

Cha et al. hypothesized that sleep spindle and slow oscillation (SO) activity is impaired in restless legs syndrome and that this dysfunction may contribute to sleep disturbance in these patients. To address this issue, they characterized sleep spindle and SO activity in Restless legs syndrome.

Fifteen drug-naive, idiopathic RLS patients (13 female and 2 male) and 15 female healthy controls participated in this study. Nineteen-channel electroencephalograms were obtained during polysomnographic (PSG) recordings. An automated sleep spindle and SO detection algorithm were used to detect sleep spindle (12-16 Hz) and SO (<1 Hz) activity. The quantitative characteristics of sleep spindle and SO activity were investigated.

Compared with the healthy controls, in RLS patients, we observed density and power reduction in sleep spindles. In SOs, density reduction and duration increment were shown in RLS patients. In addition, SO-spindle coordination was deficient in RLS as revealed by reduced SO locked spindle power, dispersed and delayed spindle phase, and decreased SO-spindle coupling. Although sleep spindle power was negatively correlated with wake after sleep onset (WASO) time, SO duration was positively correlated with the arousal index in Restless legs syndrome.

This study suggests that sleep disturbances may be mediated by a combined deficit in spindle and SO activity and SO-spindle coordination. The abnormal SO and spindle activity observed in RLS support the notion that thalamocortical abnormalities underlie this condition and may promote disturbed sleep integrity [1)].

A multiscale model provides a platform for the principled quantitative integration of existing information relevant to the generation of sleep spindles, and allows the implications of future findings to be explored. It provides a proof of principle for a methodological framework allowing large-scale integrative brain oscillations to be understood in terms of their underlying channels and synapses [2)].

1)
Cha KS, Kim TJ, Jun JS, Byun JI, Sunwoo JS, Shin JW, Kim KH, Lee SK, Jung KY. Impaired slow oscillation, sleep spindle, and slow oscillation-spindle coordination in patients with idiopathic restless legs syndrome. Sleep Med. 2019 Oct 31;66:139-147. doi: 10.1016/j.sleep.2019.09.021. [Epub ahead of print] PubMed PMID: 31877505.
2)
Rosen BQ, Krishnan G, Sanda P, Komarov M, Sejnowski T, Rulkov N, Ulbert I, Eross L, Madsen J, Devinsky O, Doyle W, Fabo D, Cash S, Bazhenov M, Halgren E. Simulating human sleep spindle MEG and EEG from ion channel and circuit level dynamics. J Neurosci Methods. 2018 Oct 6. pii: S0165-0270(18)30310-8. doi: 10.1016/j.jneumeth.2018.10.002. [Epub ahead of print] PubMed PMID: 30300700.