Sleep dysfunction

Deep brain stimulation (DBS) of the subthalamic nucleus (STN) may improve sleep dysfunction, a common non-motor symptom of Parkinson's disease (PD). Improvement in motor symptoms correlates with DBS-suppressed local field potential (LFP) activity, particularly in the beta frequency (13 - 30 Hz). Although well-characterized in the short term, little is known about the innate progression of these oscillations across the sleep-wake cycle. Baumgartner et al. sought to characterize LFP fluctuations over several days and nights in the home setting in patients chronically treated with DBS.

LFPs in the beta and alpha frequency range were recorded from the STN in 13 PD subjects (18 hemispheres) over 14.6 (interquartile range 4) days. Sleep and wake were determined by validated actigraphy. Baumgartner et al. from the University of Colorado Anschutz Medical Campus, Aurora, CO USA calculated the mean difference between sleep and wakefulness in LFP power (μVp), probability density functions of normalized LFP, and the fraction of overlap between probability density histograms.

STN LFPs showed a consistent fluctuation based on behavioral state. LFP power was higher during wakefulness than during sleep, with little overlap in the magnitude of LFP power between these two states. Delineation of subject activity patterns revealed that LFP variance by time of day was more strongly correlated at night.

STN LFP fluctuations represent a useful measure to distinguish between sleep and wakefulness in PD. These fluctuations can be detected in the home setting using commercially available devices, including in patients who have been treated with DBS for years. This technology may lead to opportunities for closed-loop DBS therapy [1)].

Baumgartner et al.'s study offers novel insights into the dynamics of subthalamic nucleus (STN) local field potentials (LFPs) during the naturalistic sleep-wake cycle in Parkinson's disease (PD) patients undergoing chronic deep brain stimulation (DBS). The study's findings suggest that LFPs can serve as an effective measure for distinguishing between sleep and wake states, with potential applications in personalized closed-loop DBS systems that adapt to real-time patient behavior. The study’s real-world application of home monitoring also holds great promise for improving patient care outside of clinical settings.

However, the study is not without its limitations, including its small sample size, focus on LFPs alone, and short-term monitoring period. Future research should expand on these findings with larger, more diverse cohorts, and incorporate additional data sources to better understand the mechanisms by which DBS influences sleep disorders in PD. Nevertheless, the study marks a critical step toward developing more adaptive and personalized DBS therapies, particularly in the context of improving non-motor symptoms such as sleep disturbances in PD.

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Baumgartner AJ, Hirt L, Amara AW, Kern DS, Thompson JA. Diurnal fluctuations of subthalamic nucleus local field potentials follow naturalistic sleep-wake behavior in Parkinson's disease. Sleep. 2025 Jan 11:zsaf005. doi: 10.1093/sleep/zsaf005. Epub ahead of print. PMID: 39798074.