EFFICACY OF LOW AND HIGH FREQUENCY DEEP BRAIN STIMULATION IN EPILEPSY

P. Boon T. Wyckhuys K. Vonck R. Raedt
Department of Neurology, Reference Center for Refractory Epilepsy, Ghent University Hospital, Gent, Belgium

Purpose: Deep brain stimulation using a neurocybernetic device and intracranially implanted electrodes is currently being investigated as a treatment for refractory epilepsy. Several brain structures such as the cerebellum and the thalamus have been targeted. At Ghent University Hospital a pilot trial in patients using hippocampal DBS has shown a significant reduction in seizure frequency in patients with temporal lobe epilepsy. The current stimulation parameters that are being used are not evidence based. Further improvement of clinical efficacy may result from research towards the identification of optimal stimulation parameters in specific seizure types. This study investigated the efficacy of hippocampal DBS using two different stimulation frequencies in a validated animal model for temporal lobe epilepsy.
Methods: Twenty rats were transformed into epileptic rats using the alternate day rapid kindling model that makes use of electrical stimuli in the amygdala. When fully kindled, these rats have a seizure each time an electrical stimulus is administered in the hippocampus. For therapeutic hippocampal stimulation rats were divided into a 130 Hz (HFS) group and a 5 Hz (LFS) stimulation group. Rats received 10 days of therapeutic hippocampal DBS. During and after termination of therapeutic DBS, seizures were evoked in all rats using the amygdalar electrical stimulation. Typical seizure characteristics such as after discharge (AD) threshold, latency and duration were compared between both treatment groups.
Results: During HFS, AD threshold and AD latency showed a significantly larger increase ($P<0.05$ and $p<0.005$ respectively) compared to the rats that received LFS ($p=0.48$ and $p<0.05$ respectively).In the HFS group the AD duration was shorter ($p<0.05$) compared to baseline. This was not observed in the LFS group. After termination of DBS, effects faded out slowly.

Discussion and Conclusion: Both HFS and LFS of the hippocampus in epileptic rats resulted in reduced excitability that is typical for epileptic seizures. When HFS and LFS were compared, HFS was more efficacious the n LFS as reflected in a higher AD threshold and AD latency and a shorter AD duration during treatment. This study is the first to show clear evidence in favour of HFS of the hippocampus to treat seizures.