The thalamus facilitates stimulus-evoked beta oscillations in the primary motor cortex: a TMS-EEG study in Parkinson's disease patients with unilateral ventrolateral thalamotomy

Van der Werf YD, Sadikot AF, Strafella AP, Paus T
Montreal Neurological Institute, Montreal, Quebec, Canada

Beta oscillations (13-30 Hz) constitute the dominant electrophysiological signal recorded over the human precentral gyrus in the resting state. We have shown previously that beta oscillations can be induced by single pulses of Transcranial Magnetic Stimulation (TMS) applied over the primary motor cortex (Paus et al, J Neurophysiol, 2001). The brain circuitry involved in generating the beta oscillations is not well understood. We wanted to study whether the thalamus contributes to such stimulation-induced cortical beta oscillation. We used single-pulse TMS to elicit beta responses in Parkinson's Disease patients with unilateral surgical lesions of the ventrolateral nucleus of the thalamus. We administered 50 single pulses of TMS, at an intensity of 120% of resting motor threshold, over the left and right primary motor cortex in eight patients and recorded EEG using a 60-electrode cap. All patients were on their regular medication at the time of testing and had an average UPDRS score of 23.7, sd 5.6 (range: 13-28). Analysis of the data showed that stimulation of the operated hemisphere induced beta oscillations of lower amplitudes, as compared with the unoperated side (paired T-test: $p<0.05$). We suggest that thalamocortical projections make the cortical neuronal ensembles more sensitive to stimulation; such a stimulation then leads to a larger response at the frequency intrinsic to that region. Alternatively, the thalamus facilitates the beta oscillatory response by phase-locking of separate cortical neuronal ensembles.

Ysbrand D van der Werf, Netherlands Institute for Brain Research, Meibergdreef 33, 1105 AZ Amsterdam, t 020 5665500, e-mail y.van.der.werf@nih.knaw.nl

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