Deep brain stimulation impairs on-line executive control in Parkinson's disease patients

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Abstract

High frequency DBS is thought to inactivate the subthalamic nuclei (STNs) and to restore the thalamo-cortical projections impaired by PD. This therapy dramatically improves PD motor symptoms. Recent fMRI data collected in healthy volunteers suggest that the STNs are involved in the urgent inhibition of ongoing actions. We reasoned that a side effect of DBS could be to impair this ability in PD patients. 16 PD patients treated by DBS for performed a conflict reaction time (RT) task involving thumb responses in 4 treatment conditions: Stimulator ON – Medication ON, Stimulator OFF – Medication ON, Stimulator ON – Medication OFF, Stimulator OFF – Medication OFF. The electromyographic activity of the response agonists was recorded and analysed, allowing the detection of partial errors, that is of subliminal activations of the muscles involved in erroneous responses. Responses were thus classified in 3 categories: correct, partial errors and overt errors. The medication exerted no notable effect on the patients' performance. DBS shortened correct RT but increased the overt error rate and decreased the number of partial errors. Analyses of the temporal distribution of the 3 response categories revealed that the increase in overt error rate observed when the stimulator was ON was specifically due to a failure to detect, inhibit and correct partial errors before they resulted in overt erroneous responses. While it improves motor performance and shortens RT, DBS impairs the patients' faculty to suppress erroneous response activations as revealed by their inability to counteract partial errors when the stimulator was ON.

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