Deep Brain Stimulation of the Posterior Subthalamic Area in the Treatment of Movement Disorders

Akademisk avhandling

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Abstract

Background: The posterior subthalamic area (PSA) is essentially composed of the caudal Zona incerta and the prelemniscal radiation. Subthalamotomy in the PSA was renowned for its effectiveness in alleviating movement disorders and particularly tremor. The modern literature on DBS of this area is limited, but promising results have been presented for Parkinson’s disease (PD), essential tremor (ET) and other movement disorders.

Aim: To evaluate the safety of PSA DBS with emphasis on the panorama of side effects, the distribution of stimulation-induced side effects and the effects of PSA DBS on verbal fluency. To evaluate the therapeutic effect of PSA DBS on less common forms of tremor, tremor-dominant PD, and concerning the long-term results in ET.

Method: 40 patients were evaluated regarding side effects of the procedure. 28 patients with ET were analyzed for stimulation-induced side effects in a standardized manner. The locations of the contacts that caused stimulation-induced side effects were plotted on atlas slides. A 3-D model of the area was created based on these slides. Verbal fluency was analyzed in 17 patients with ET before surgery, after 3 days and finally after 1 year. Five patients with less common forms of tremor and 18 with ET were evaluated according to the ETRS at baseline and one year or 3-5 years after surgery, respectively. 14 patients with mainly unilateral tremor-dominant PD were evaluated a mean of 18 months after surgery according to the motor part of UPDRS.

Results: PSA DBS was associated with few serious side-effects, but a transient and mild postoperative dysphasia was found in 22.5% of the patients. There was a slight transient decline in the performance on verbal fluency tests immediately after surgery. Visualization of the contacts causing stimulation-induced side effects showed that identical responses can be elicited from various points in the PSA and its vicinity. The effect on the less common forms of tremor was excellent except for neuropathic tremor where the effect was moderate. A pronounced and sustained microlesional effect was seen for some of the patients. After a mean of 4 years with unilateral PSA DBS the total ETRS score was improved by 52.4%, tremor by 91.8% and hand function by 78.0% in the patients with ET. There was no increase in the stimulation strength over time. In PD, the scores improved 47.7% for contralateral UPDRS III. Contralateral tremor, rigidity, and bradykinesia improved by 82.2%, 34.3%, and 26.7%, respectively.

Conclusions: PSA DBS generally seem to be a safe procedure, but it may be associated with transient declines of verbal fluency. There was no clear somatotopic pattern with regard to stimulation-induced side effects in the PSA. PSA DBS can alleviate tremor regardless of the etiology. The long-term effects in ET were favorable when compared to our previous results of Vim DBS. The effect on Parkinsonian tremor was satisfying, however, the reductions of rigidity and bradykinesia were less compared to previous studies of PSA DBS for PD.

Keywords: Deep brain stimulation, Movement disorders, Posterior subthalamic area, Zona incerta, Prelemniscal radiations, Tremor, Essential tremor, Parkinson’s disease.