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SOMATOPOIESE observée dans le Gpi: analyse d’effets moteurs indésirables au cours d’une stimulation cérébrale profonde chez un patient parkinsonien
(Somatoptopie in the Gpi: Analysis of Motor Side Effects during Intraoperative Assessment in a Parkinsonian)

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INTRODUCTION

A somatotopie inside the human globus pallidus (GP), based on intra operative microelectrode-recordings during passive or active movement and on clinical results of deep brain stimulation (DBS) in movement disorders, has been described in the literature (2,7,9). We aimed at reporting a GP somatotopie, observed in one parkinsonian patient by dystonic motor side effect assessment during acute stimulation, and to MRI anatomy.

MATERIAL AND METHODS

History
A 65-year-old right-handed woman suffered from Parkinson's disease for 16 years, initially affecting the right upper limb with tremor. Before surgery, dyskinesia was encountered for the upper and the lower limbs, for the trunk with alternatively, severe blocking episodes. Moreover, an important bradykinesia was observed with chin and upper limb tremor.

Surgical technique
Stereotactic MRI. On the first day, the stereotactic Leksell G frame (Elekta, Sweden) was placed with its repositioning kit (Leksell repositioning kit, Elekta, Sweden) under local anesthesia. A stereotactic MRI was performed (Sonoda 1.5 Tesla, Siemens, Germany) in three orthogonal planes (axial, coronal and sagittal). The voxel size was 0.52 × 0.52 × 2.09 mm3 (field of view : 272 mm, slice thickness = 2 mm). A Turbo Spin Echo (TSE-TSE) sequence was used for the axial and the sagittal planes: TR = 2000 ms, TE = 15 ms, matrix 256 × 256. A White matter/Attenuated Inversion Recovery (WMI) sequence was used for the coronal plane: TR = 2000 ms, TE = 15 ms, thickness 10 mm, matrix 256 × 256 images (the stereotactic axis). The frame was removed.

Planning: Direct targeting of GP was performed using a stereotactic software (plan, BrainLab, Germany). We identified all the segments of the Globus Pallidus (GP); GP is commonly divided in two parts (2,3): the lateral and the medial segments, respectively named external GP (GPe) and internal GP (GPi). An anatomic somatic or somatic parasitic approach, in a basal and posterior position, partially separates the GPi into a lateral (GPil) and a medial (GPim) substructure (4,5,6,7). With the help of probe view reconstructions, we determined a trajectory, with a double obliquity, avoiding the main vessels, going strictly the thalamus and with an epicenter located at the lower boundary of the structure; we schematically placed the end point at the junction between the 3rd and the 4th quarter of GP according to its main Antero-posterior axis (1). We planned three parallel tracts, a central one centered on the best anatomical target, a 2mm-lateral one and a 2mm-medial one on the left hemisphere. When surgery, an electrode was placed in the selected tract (the central one for both) with one or two contacts in the clinically most efficient area. Peroperative tale radiographs X-rays controls and postoperative non-stereotactic coronal T2-TSE MRI acquisitions were performed to control the electrode positioning.

Postoperatively, chronic DBS dramatically improved dyskinesia (electrodes implanted on the central tracts).

A SOMATOPOIESE OF DYSTONIC MOTOR SIDE EFFECTS WAS ENCOUNTERED INSIDE EACH PALLIDAL STRUCTURE

1. GPi, lateral GPi and GPi medial (GPim) seemed to be characterized by a segregated body map.

Contralateral dystonic movements were noted during acute intraoperative stimulation and represented as pictograms along the distal 10mm on 3 parallel tracts on each side using probe views. Central (C), anterior (A) and lateral (L) tracts are explored on the Right pallidum and central (C), medial (M) and lateral (L) trajectories on the Left one. A scale represents the 10mm course of the stimulation exploration. (figures 1b and 1c)

Axial slices with surrounded structures are illustrated for the position -8mm, -4mm then 0mm on the central tracts (figures 1a and 1d).

We found inside each structure (GPe, GPi lateral and GPi medial) a rostro-caudal somatotopic organisation

- face
- upper limb | superior part
- lower limb | intermediate part
- lower limb | inferior part.

Post surgery clinical results.
- Initially, GPI DBS totally abolished dyskinesia.
- 3 months after the surgery + adverse effect, dyskinesia improved by 30% voltage.
- 6 months post surgery + 80% improvement on dyskinesia (auto evaluation) + minor efficiency on other parkinsonian symptoms.
- somatoptopie of stimulation induced dystonia found with the Right DBS electrode (figure 2).

DISCUSSION

The somatoptopie organization analysis is an interesting spin-off of intra operative motor side effect analysis. The GP somatotopie related to these clinical conditions has to be confirmed.

Studies have reported a somatotopy of clinical effect (dystonia (9), dyskinesia (2)) or a spatial organization of kinesthetic cells in Parkinsonian GP (7). Techniques of localization of clinical effects or anatomical structures should influence the results and have to be refined as proposed with our patent based approach.

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