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Deep brain stimulation of the Dentato-Rubro-Thalamic tract in a case of post-lesional Holmes tremor: a CSD guided procedure

Valeria Pozzilli[1], A. Bonura[1], A. Magliozzi[1], V. Di Lazzaro[1], C.A. Mallio[2], D. Marruzzo[3], F.R. Barbieri[3], R. Ricciuti[3], M. Marano[1]

[1]Neurology, Neurobiology and Neurophysiology Unit, Fondazione Policlinico Universitario Campus Bio-Medico, Rome, Italy
[2]Neuroradiology Unit, Fondazione Policlinico Universitario Campus Bio-Medico, Rome, Italy
[3]Neurosurgery Unit, Ospedale Belcolle di Viterbo, Viterbo, Italy

Introduction: Holmes tremor (HT) is an irregular, slow-frequency (<4.5 Hz) tremor that arises as a delayed manifestation of lesions in the upper brainstem such as stroke. Thalamic deep brain stimulation (DBS), mainly ventralis intermediate nucleus (VIM) DBS, is currently adopted for the neuromodulation of tremor of various origin. However, due to inconsistent results, other targets (GPi, ZI, VOA, VOP) are currently under investigation. More recently, the constrained spherical deconvolution (CSD) based tractography, in place of the standard diffusion tensor imaging (DTI) based tractography, has been shown to characterize intra voxel diffusion behavior and therefore identify the complex architecture of the dentato-rubro-thalamic tract (DRTT) as a potential target for treating tremor [2].

Case description: A 51-year-old woman presented to our clinic with a disabling right-sided rest tremor, secondary to a left ponto-mesencephalic hemorrhage occurred 5 years before. The tremor affected mainly her upper right arm, had a slow frequency (3-4Hz) and persisted during movement. The medications she had taken until then had failed in the control of her symptoms. We therefore addressed her to an imaging and neurophysiology guided awake DBS procedure. The pre-surgical planification included advanced neuroimaging with constrained spherical deconvolution (CSD) based tractography obtained from diffusion weighted imaging (DWI) in order to identify with extreme precision the DRTT. During the operation we observed a striking improvement of the tremor, without notable side effects. A Percept PC neurostimulator with a directional (Sensight) lead was placed. The patient was then programmed aiming at a multitarget approach (caudal VIM + DRTT) leading to an almost complete tremor suppression (80%).

Discussion: To date clinical manifestations of HT have implicated the involvement of the nigrostriatal system, the cerebello-thalamo-cortical pathway and the dentate-rubro-olivary pathway. Thanks to the innovative pre-operative reconstruction of nervous pathways with CSD tractography and intraoperative visualization of the lead during awake DBS, DRTT was effectively targeted. A significant benefit on our patient's tremor was obtained, paving the way towards the use of new promising neuroimaging techniques able to target the pathways involved in the pathogenesis of HT.

References:

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