

**STAGED BILATERAL STEREOTACTIC PALLIDO-THALAMOTOMY FOR LIFE-
THREATENING DYSTONIA IN A CHILD WITH HALLERVORDEN-SPATZ
DISEASE**

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ABSTARCT

Hallervorden-Spatz disease (HSD) is a rare disorder characterized by progressive motor dysfunction and dementia. Dystonia is the most prominent and disabling symptom responding only to a modest extent to pharmacological therapy. At the moment only a few cases have been reported to improve dystonia and even fewer to resolve status dystonicus for a longer period in children.

The authors present the case of a 10-year-old boy who had progressive generalized dystonia resulting in spontaneous femur fracture and life-threatening swallowing and respiratory disability. As a rescue solution staged bilateral pallido-thalamotomy was performed. Postoperatively, Burke-Fahn-Marsden Dystonia and Disability Rating Scales improved (from 116 and 30 points to 41 and 18 points) and painful dystonia was resolved, which was still continuous 4 years later (47 and 20 points).

Stereotactic staged bilateral pallido-thalamotomy should be considered as a potential treatment in the management of life-threatening generalized dystonia related to HSD.

Abbreviations: HSD=Hallervorden-Spatz disease, AC=anterior commissure;

BFMDRS=Burke-Fahn-Marsden Dystonia Rating Scale; DDRS=Dystonia Disability Rating Scale, DBS=deep brain stimulator; GPi=internal globus pallidus; PC=posterior commissure;

VIM=ventral intermedial nucleus of thalamus.

INTRODUCTION

HSD is a rare, autosomal recessive disorder characterized by progressive motor symptoms and dementia affecting mainly children. Diagnosis is based on clinical symptoms and MR imaging^{1,2}.

Pharmacological therapy has a limited efficiency and the disease progresses to severe disability and death. However, ablation and DBS implantation have been reported to provide some measure of dystonia reduction³⁻⁵, but the results are sometimes conflicting⁶.

We present the case of a child who had severe, generalized dystonia refractory to pharmacological treatments. Staged bilateral pallido-thalamotomy was considered when the disease resulted in life-threatening status dystonicus.

CASE REPORT

History

The 10-year-old boy was born from the first gravidity of unrelated parents. The pregnancy was uncomplicated; the delivery was spontaneous, at term. His perinatal adaptation and motor development were normal.

At the age of 5 his parents noticed progressive gait disturbances and difficulty in speech. Physical examination revealed generalized dystonia, dysarthria and retinitis pigmentosa. Laboratory tests were in the normal range including copper level and coeruloplasmin. Arylsulphatase, beta-hexoseaminidase, beta-galactosidase, and CSF protein turned to be normal, as well. Brain MRI revealed decreased signal intensity in both basal ganglia and small areas of hyperintensity in their internal segments on T2 weighted images (“eye of the tiger” sign)⁷. (**Figure 1**) The diagnosis of HSD was established¹, however, genetic background was not proved. Several pharmacological therapies to reduce the dystonia were tried with temporary effect (levodopa/carbidopa, trihexyphenidyl, clonazepam, diazepam, baclofen, bromocriptine, amantadine).

In 2001, at the age of ten, he developed status dystonicus. Life-threatening, severe generalized dystonia was accompanied by inspiratoric dyspnoe and acute bronchitis. After tracheotomy he had been ventilated, relaxed. BFMDRS⁸ was 116 points (maximum 120) while DDRS⁸ was 30 points (maximum 30). The observed status dystonicus was completely resistant to drug therapy, so the team decided to perform ablative surgery as a rescue solution.

Operation

Since the patient had continuous, severe dystonic-hyperkinetic movements, he had to be sedated by using propofol. T1- and T2-weighted MR sequences were performed with a 1.0 Tesla MR imager (Siemens AG, Germany) to identify the midsagittal plane, the AC and PC. The target in the internal segment of the globus pallidus (GPi) was calculated 2 mm anterior

to the midcommissural point, 3 mm below the AC-PC line, and 19 mm left to the midline. The target was confirmed anatomically both on T1 and T2 images. Semi-microelectrodes (CRW Radionics, 1 Mohm of impedance) were used for the localization of the appropriate target where good recording of pallidal cell activity was found (**Figure 2**) and no tetanic muscle contraction could be observed during stimulation (100Hz, 0.5 ms, 3 V). Lesions were then made at the level and also 3 mm higher along the path, with the lesion generator set at 75°C for 1 minutes each. A second pairs of lesions were made in the tract of the next-to-last pass, which was 3 mm farther anterior. When the patient was awakened, only a mild reduction in dystonic movements on the contralateral side was noticed. Bearing in mind the mild relief of symptoms related to pallidotomy, targeting of the VIM nucleus was decided. The thalamic target was calculated proportionally to standard anatomical points (in this case 6.9 mm anterior to PC, 11.6 mm lateral to the midline at the AC-PC plane). Semi-microrecording of the thalamic VIM target was performed where irregular bursting activity was found (**Figure 2**) responding to joint movements of the contralateral extremities. After stimulation of the target two permanent lesions (at the level of target and 3 mm higher along the trajectory) were made. The patient was awakened and no evidence of dystonic movements in the extremities on the contralateral side was noticed. Postoperatively MRI images were obtained (**Figure 1**). While the relief of dystonia contralateral to the ablation was continuous, the dystonia in the ipsilateral extremities exaggerated two days after operation resulting in spontaneous femur fracture. Caster fixation of femur was decided because of the second stage stereotactic surgery.

Since the first multitarget operation resulted in fast relief of symptoms, we were convinced of the efficacy of the same intervention on the contralateral side. For the first step only pallidotomy was decided. The lesions were made at the same sites as in the previous operation. The mild reduction of dystonic movements after pallidotomy and the potential risks

related to the fractured bone dislocation made us to target also the VIM nucleus expecting fast effect. The procedure was performed the same way as during first operation. After pallido-thalamotomy no evidence of dystonic movements was noticed. Postoperative MR images demonstrated the placement of ablations (**Figure 1D**).

Postoperative course

After the second surgery the patient immediately improved; the painful distal limb and axial dystonia has resolved. He could swallow and play with his friends again. With help he could take a few steps, however, he is still unable to take longer walk. BFMDRS improved to 41 points, while DDRS to 18 points. At time of 4 years follow-up his condition was stable, there was no evidence of recurrent symptoms (47 and 20 points, respectively).

DISCUSSION

Among the symptoms of HSD dystonia is one of the most disabling, which can affect any part of the body. Pharmacological therapy can alleviate dystonia temporarily to only a modest extent.

Ablative stereotactic interventions were tried in various dystoniform diseases successfully^{9, 10}. As DBS implantation came into general use to relieve Parkinsonian symptoms, its advantages became obvious. Consequently, in the last couple of years DBS implantation also replaced ablative methods to control dystonia^{5, 11-13}. By analyzing the targets of various DBS implantations, GPi turned to be the most effective¹⁴, while thalamic targets were less effective¹⁵ and subthalamic targets were ineffective⁶ to control generalized, non-parkinsonian dystonia.

Moreover, the efficiency of neurosurgical treatments also differs in primary and secondary dystonia^{5, 14, 15}. Since much less data is available on secondary dystonia, there are only few reports on surgical treatment of HSD. Staged, bilateral thalamotomy⁴, bilateral¹⁶ and unilateral³ pallidotomy were reported. Most recently Umemura¹⁴ used the first reported bilateral pallidal DBS implantation for treating secondary dystonia observed in HSD with success.

At the time of our case, in January, 2001, the authors were aware of the advantages of DBS in the treatment of Parkinsonian dystonia, but in case of HSD it had not been proven. However, ablation seemed to be applicable on children and effective to reveal severe, acute dystonia^{3, 4}.

In our case the ablation and semi-microelectrode recording was made in the state of propofol-induced anesthesia. Notwithstanding that propofol alters the firing pattern¹⁷ of GPi, similarly to Justesen³ we found responding units during targeting.

It is known that dystonia sometimes decreases weeks after stereotactic procedures. However, in our case the patient was in life-threatening status dystonicus for weeks. Although

pallidotomy brought mild immediate relief of dystonia, this desperate circumstance urged us to achieve fast surgical result and not waiting for delayed effect. The dystonia-related spontaneous femur fracture also confirmed the severity of symptoms. Since the first pallido-thalamotomy resulted in fast relief of symptoms, we decided to apply the same intervention on the contralateral side. However, it remains an interesting question whether bilateral pallidotomy or thalamotomy would have been effective in eliminating severe dystonia after a period of time or the combined bilateral pallido-thalamotomy was necessary to achieve the most efficient result.

In our case staged bilateral pallido-thalamotomy eliminated status dystonicus permanently. BFMDRS improved from 116 to 41 points, while DDRS from the maximum 30 points to 18 points. After four year follow-up, the dystonia reduction was continuous (47 and 20 points).

It may be established that in case of drug resistant, life-threatening status dystonicus, ablative surgical procedures should be considered as a potential treatment in children. Our results suggest that when monotarget ablation (i.e. pallidotomy) proves to be not effective enough to abolish status dystonicus, multitarget ablation (pallido-thalamotomy) seems to be an acceptable surgical option.

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FIGURES

Figure 1

(A) Coronal T2 weighted and (B) axial FLAIR MR images taken at the age of 6. Note the “eye of the tiger” sign. (C) Axial T2-weighted image made immediately after the first operation. (D) Axial T1-weighted image taken after the second stage intervention.

Figure 2

(A) Semi-microrecording of the GPi firing at a rate of 50 discharge/second spontaneously, (B) 79 discharge/second for passive upper and lower limb flexion and extension during propofol-induced anesthesia. (C) Semi-microrecording of the thalamus in the region of the Vim revealed irregular bursting activity.

Figure 1

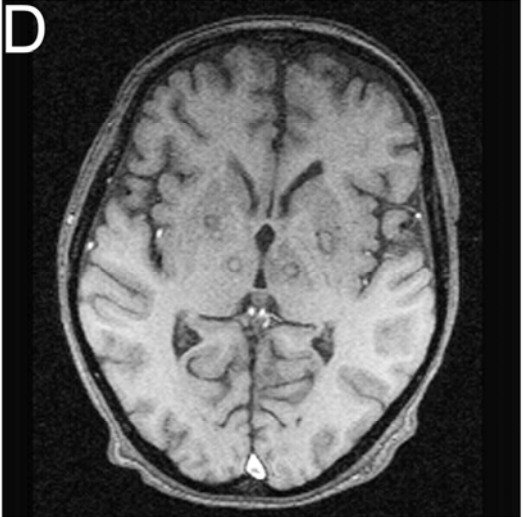
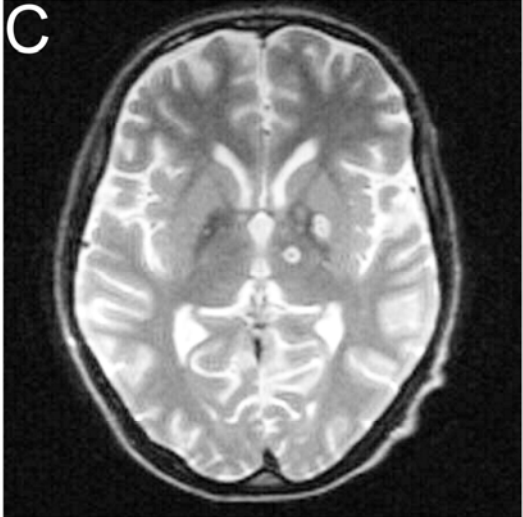
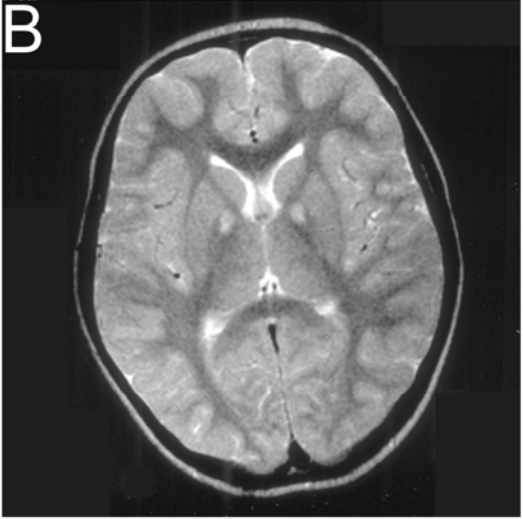
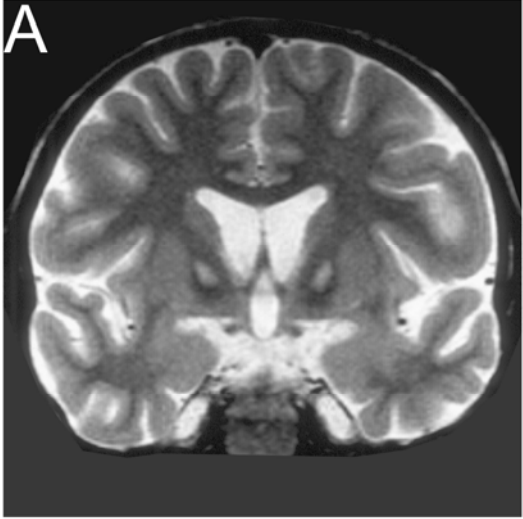


Figure 2

