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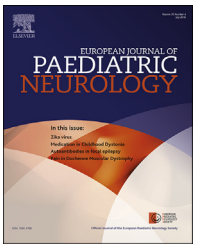

Original article

Stable cognitive functioning with improved perceptual reasoning in children with dyskinetic cerebral palsy and other secondary dystonias after deep brain stimulation

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ABSTRACT

Background: Dystonia is characterised by involuntary movements (twisting, writhing and jerking) and postures. Secondary dystonias are described as a heterogeneous group of disorders with both exogenous and endogenous causes. There is a growing body of literature on the effects of deep brain stimulation (DBS) surgery on the motor function in childhood secondary dystonias, however research on cognitive function after DBS is scarce.

Methods: Cognitive function was measured in a cohort of 40 children with secondary dystonia following DBS surgery using a retrospective repeated measures design. Baseline pre-DBS neuropsychological measures were compared to scores obtained at least one year following DBS. Cognitive function was assessed using standardised measures of intellectual ability and memory.

Results: There was no significant change in the assessed domains of cognitive function following DBS surgery. A significant improvement across the group was found on the Picture Completion subtest, measuring perceptual reasoning ability, following DBS.

Conclusion: Cognition remained stable in children with secondary dystonia following DBS surgery, with some improvements noted in a domain of perceptual reasoning. Further research with a larger sample is necessary to further explore this, in particular to further subdivide this group to account for its heterogeneity. This preliminary data has potentially positive implications for the impact of DBS on cognitive functioning within the childhood secondary dystonia population.

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1. Introduction

Dystonia is a movement disorder characterised by involuntary, sustained muscle contractions resulting in twisting, repetitive movements and abnormal postures[1,2] and has been aetiologically classified as falling within either a primary or secondary group.[3] Secondary dystonias are described as a heterogeneous group of disorders with both exogenous and endogenous causes, including dyskinetic cerebral palsy[4,5] (CP), hypoxic-ischaemic, inflammatory and neuro-metabolic conditions such as hyperbilirubinaemia, glutaric aciduria type-I and mitochondrial disorders.[4,5] The secondary dystonia group also encompasses neuro-degenerative conditions, such as neuro-degeneration with brain iron accumulation (NBIA).[6] Considering the heterogeneity that exists within the dystonia population it is important to separately explore the varying diagnoses due to the differing phenotypes and varied responses to treatment.[7]

Deep brain stimulation (DBS) of the internal globus pallidus (GPi) has been used to successfully manage dystonia, in both children and adults with a diagnosis of primary dystonia.[8–10] With more modest improvements than the primary dystonia group, recent studies have highlighted the benefits of DBS for motor function in children and adults with secondary dystonias.[11–13] The management of movement disorders in children is complex and lacks class I evidence of efficacy.[14] The main criteria for considering DBS within this group is the reported poor quality of life and high disability that is not responsive to medical treatment.[15]

While our understanding of the motor impact of DBS on dystonia broadens, there is still much to be learnt about the non-motor effects of DBS within the dystonia population. Investigating these effects, in particular cognitive function, has been recommended as part of the overall surgical process.[16] Much of the research to date has focussed on the cognitive outcomes of DBS surgery within adult primary dystonia populations. Findings within this cohort have been mixed with some studies reporting preserved or improved cognitive function[17] and others reporting a decline across certain domains of function.[18] With regard to the impact of DBS on paediatric cognitive functioning within a primary dystonia group, our group has previously reported individual fluctuations in cognitive function, but overall, cognition largely remains stable before and after DBS surgery.[19]

Due to the heterogeneity of the dystonia population, the literature calls for further exploration regarding the possible impact of DBS on cognitive function in individuals with secondary dystonia,[19] particularly dyskinetic CP. Research investigating this is currently sparse, particularly within the paediatric group.

Within the adult population, a group of 13 individuals with dyskinetic CP were assessed before and after DBS and it was found that there was no worsening of cognition following surgery.[20] Similar results have been reported within a paediatric population, specifically within a cohort of children with Neurodegeneration with Brain Iron Accumulation (NBIA).[21] NBIA is a neurodegenerative disorder that has been associated with cognitive decline; hence it is a particular area of interest when investigating the impact of DBS on cognition in secondary dystonia. This study reported no cognitive decline within this group following DBS surgery and indeed, improvements in functioning in certain domains. The researchers suggest that the findings were likely to be a result of improved concentration and access to test materials after DBS dystonia moderation.

There is a need for further research to explore these preliminary findings and broaden our understanding of cognition after DBS within the paediatric secondary dystonia population. This is an important area of study due to the developing nature of the child's brain, and is needed in order to broaden the evidence-base for this population. Our objective was to assess global cognitive ability and memory in a group of children with secondary dystonia who have undergone bilateral pallidal DBS.

2. Method

2.1. Design

This is a retrospective study of a cohort of 40 children and young people with secondary dystonia using a within groups design. All patients were under the care of a tertiary hospital specialist complex motor disorders service (CMDS). All assessments were performed routinely as part of the service's clinical protocol between 2007 and 2015 and the data constitutes a service evaluation for which ethical approval is not required.

2.2. Participants

All patients under the care of the service with a confirmed diagnosis of secondary static or secondary progressive dystonia and at least one year follow up data post-DBS were included in this study (n = 40). Thirty three patients had a secondary static and seven patients had a secondary progresssive dystonia. Patients were diagnosed and classified by the Consultant Paediatric Neurologist (JPL). The mean age of participants at the time of surgery was 12.5 years (SD = 3.53; range = 5–18 years). Nineteen patients were male and 21 were female. Twenty-two/40 had a diagnosis of CP which is the commonest cause of dystonia in childhood. All patients with NBIA experienced blepharospasms.

DBS surgery was performed under general anaesthetic using MRI-guided postero-latero-ventral globus pallidus targeting as reported elsewhere.[22]

2.3. Measures

Cognitive functioning was assessed using standardised measures. For each child, the measures used depended on their age and ability to physically and verbally access the materials. The measures used were:

1. *Non-verbal intellectual abilities:* The Perceptual Reasoning Index subtests of the Wechsler Scales of Intelligence IV:

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