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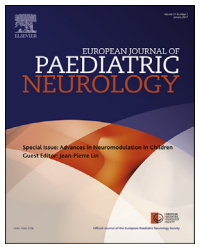

Review article

Historical developments in children's deep brain stimulation

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ABSTRACT

Background: Heterogeneous by the underlying pathobiology and clinical presentation, childhood onset dystonia is most frequently progressive, with related disability and limitations in functions of daily living. Consequently, there is an obvious need for efficient symptomatic therapies.

Methods and Results: Following lesional surgery to basal ganglia (BG) and thalamus, deep brain stimulation (DBS) is a more conservative and adjustable intervention to and validated for internal segment of the globus pallidus (GPi), highly efficient in treating isolated "primary" dystonia and associated symptoms such as subcortical myoclonus. The role of DBS in acquired, neurometabolic and degenerative disorders with dystonia deserves further exploration to confirm as an efficient and lasting therapy. However, the pathobiological background with distribution of the sequellae over the central nervous system and related clinical features, will limit DBS efficacy in these conditions. Cumulative arguments propose DBS in severe life threatening dystonic conditions called status dystonicus as first line therapy, irrespective of the underlying cause.

There are no currently available validated selection criteria for DBS in pediatric dystonia. Concurrent targets such as subthalamic nucleus (STN) and several motor nuclei of the thalamus are under exploration and only little information is available in children. DBS programming in paediatric population was adopted from experience in adults. The choice of neuromodulatory DBS parameters could influence not only the initial therapeutic outcome of dystonic symptoms but also its maintenance over time and potentially the occurrence of DBS related side effects.

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Conclusion: DBS allows efficient symptomatic treatment of severe dystonia in children and advances pathophysiological knowledge about local and distributed abnormal neural activity over the motor cortical-subcortical networks in dystonia and other movement disorders.

Contents

1. Introduction

Childhood neurology accounts for a wide spectrum of diseases that encompasses, at different stages of their progression, various movement disorders, impacting development and functional capacities. Scientific progresses and technological developments over the last decades improved symptomatic treatment. However, their application in pediatric movement disorders is still limited and efficacy variable when addressing the type of movement disorder, the associated symptoms and the lack of guidance by the underlying pathobiology.

In the spectrum of pediatric movement disorders, dystonia represents the most frequent, persistent, potentially most severe and most challenging movement disorder.

According to the recently revised classification, which does not address specifically pediatric aspects, dystonia is classified along two axes: clinical characteristics, including age of onset, body distribution, temporal pattern and associated features; and etiology, which includes nervous system pathology and inheritance.[1] In children, dystonia has many diverse etiologies,[2] the underlying pathobiology as well as related phenotypes are heterogeneous and complex; age and symptom distribution at onset may sometime inform about the underlying causes. A recent study conducted in a pediatric population reported that dystonia severity frequently worsens in primary, secondary and heredodegenerative aetiologies, remaining at best static in one third of cases, meanwhile spontaneous improvement will be an exceptional scenario.[3] Childhood onset dystonia often becomes generalized, involving progressively an increasing number of body parts and impair the evolving functional capacities at various developmental stages. Furthermore, it is combined with associated neurological and systemic signs and symptoms, rendering assessment challenging and prognosis risky with significant, life-long reduction of activity and participation.[4]

2. Assessment of dystonia

Dystonia assessment is higly challenging since there is no available «perfect» dystonia rating scale with demonstrated validity, reliability, and utility across multiple forms of dystonia, combined dystonia and taking into account different ages in pediatrics. Several rating scales assessing dystonia have been developed such as the Barry-Albright Dystonia Scale (BADS)[5] and the most frequently used dystonia rating scale is the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS),[6] designed for isolated generalized dystonia. However, this scale was not validated in young children with dystonia, where the disability section score could be impacted by the developmental stage as much as by dystonia. Furthermore, in combined dystonia, disability scores can be further altered by associated symptoms.

The long time period for monitoring the disease progression and efficacy of treatment in patients with dystonia prevents the adequate use of a single assessment tool equally suitable in young children, teenagers and adults over the longitudinal follow-up. Assessment must take into account, for every point in time, the sum of the effects of the therapeutics used and of the potential disease progression, compared with the previous assesments. A stable or worse motor score compared to baseline condition does not necessarily mean that the therapeutical approach used was uneffective, but could also mean that the underlying disease