The child with dystonia

Daniel E Lumsden

Abstract

Dystonia is a movement disorder, characterized by sustained or intermittent muscle contractions causing abnormal, often repetitive, movements, postures, or both. Dystonia can be caused by a wide range of disorders affecting the nervous system and may exist either as an isolated abnormality or as one part of a more complex motor disorder. Dystonia in children may interfere with normal movements, mobility and the delivery of daily care, as well as causing problems with feeding and communication. Dystonia adversely affects quality of life. The commonest cause of dystonia in childhood is cerebral palsy. Investigation of other causes is likely to require MRI brain imaging, blood, urine and potentially CSF investigations. This should be guided by a specialist team, as should genetic testing. The evidence base to guide medication choices in dystonia is limited, and care should be taken to address potential provoking factors (e.g. pain and constipation) as well as treatments primarily designed to reduce abnormal tone. Treatment options include oral medications, botulinum toxin injections for focal elements of dystonia, and increasingly neurosurgical interventions (namely Intrathecal baclofen and Deep Brain stimulation), highlighting the importance of a rational approach to pharmacological management. This article highlights the more important aspects of diagnosis, investigation and treatment of dystonia in children.

Keywords dystonia; dyskinesia; hyperkinesia; hypertonia; spasticity; cerebral palsy

Introduction

The control of posture and movement in children is the result of the actions of a complex network distributed across many regions of the brain, interacting with both sensory and motor elements of the peripheral nervous system. In the simplest terms, dystonia is a disorder of involuntary fluctuating muscle contractions. These involuntary contractions result in unwanted movements and/or postures.

Dystonia is not a disease in and of itself, but rather a symptom of an abnormally functioning motor system. It can arise as an isolated finding in otherwise healthy children with mutations in single genes (e.g. *TOR1A*), or as one aspect of a more complex motor disorder in children with an acquired brain injury or a neurodegenerative disorder. Dystonia may affect a focal body region, the whole body, or anything in between.

The management of dystonia can be complicated, with a limited evidence base to support even the most commonly used medications (e.g. baclofen, trihexyphenydil). In recent years the management of dystonia has been revolutionised by the development of highly specialised neurosurgical techniques such as Deep Brain Stimulation. It is important to recognise though that these advanced techniques are likely to be suitable for only a small minority of children.

Daniel E Lumsden *MB/BChir MA Cantab MSc PhD FRCPCH is a Consultant Paediatric Neurologist with the Evelina London Children's Hospital, Guy's and St Thomas' NHS Foundation Trust, London, UK. Conflict of interest: none.*

Dystonia as a disorder of movement and tone

Both definition and classification of dystonia has changed over time since the term was first used in 1911 by Oppenheim to describe 4 children with fluctuating tone. The most recent consensus classification (agreed in 2013) defines dystonia as *"a movement disorder characterized by sustained or intermittent muscle contractions causing abnormal, often repetitive, movements, postures, or both"*. This consensus statement also noted: *"dystonic movements are typically patterned and twisting, and may be tremulous. Dystonia is often initiated or worsened by voluntary action and associated with overflow muscle activation"*. Dystonia can be categorised along two axes, clinical features and aetiology (Table 1).

Making sense of the symptoms and signs

When approaching a child with involuntary movements for the first time, trying to make sense of the apparently chaotic constellation of muscle jerks and twitches can seem overwhelming. *Hyperkinetic* is the term used to describe unwanted, excessive, involuntary movements in children. The term *dyskinetic* is also used to describe involuntary abnormal movements (particularly in adults), which can be confusing in paediatric practise where the term also refers to a particular form of cerebral palsy. A comparison of different hyperkinetic movements is provided in Table 2. In contrast to other hyperkinetic movements, in dystonia affected body parts are held in an abnormal posture, even if only very briefly. In children, a combination of different forms of hyperkinesia is not uncommon, e.g. Dystonia choreoathetosis following a hypoxic ischaemic insult.

As dystonia causes abnormal postures, it is also considered a form of *hypertonia*, and increased resistance to passive movement of the body part when the child is asked to relax fully. Hypertonia may be due to changes in passive tissue properties (i.e. increased viscosity and/or elasticity) and/or to involuntary muscle contraction. Other forms of abnormal muscle contraction are *spasticity* and *rigidity*, outlined in Table 2.

Dystonia as part of a broader motor disorder

Just as dystonia may be just one of a number of hyperkinetic movements a child experiences, other elements of motor difficulty may be present. Negative motor signs, may be equally, if not more disabling then increased tone or involuntary movements. Hypotonia at rest is present in many children between dystonic contractions, particularly in the axial muscle groups. Weakness is a common finding in children with dystonia, as is ataxia (an inability to perform smoothly coordinated movements).

Sometimes overlooked, but no less important, can be impaired selective motor control (impaired ability to isolate the activation of muscles in a selected pattern). Dyspraxia or even frank apraxia may also be present. It is important to consider these other motor features when evaluating the child with dystonia, as interventions to reduce dystonia will not improve these difficulties, and may even worsen them. Furthermore, abnormal tone may be used by a child to overcome negative motor

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Classification of Dystonia based upon most recent consensus update (2013)

Classification of dystonia

Axis 1: Clinical characteristics

Age at Onset
- Infancy (birth to 2 years)
- Childhood (3–12 years)
- Adolescence (12–20 years)
- Early Adulthood (21–40 years)
- Late Adulthood (>40 years)

Body Distribution
- Focal
- Segmental
- Multifocal
- Generalised (with or without leg involvement)
- Hemidystonia

Temporal Pattern
- Disease Course: Static/Progressive
- Variability: Persistent/Action-specific/Diurnal/Paroxysmal

Associated features
- Isolated Dystonia
- Dystonia combined with another movement disorder

Occurrence of other neurological or systematic manifestations

Axis 2:

Nervous System Pathology
- Evidence of degeneration
- Evidence of structural (often static) lesions
- No evidence of degeneration or structural lesions

Inherited or Acquired:

Inherited:
- Autosomal dominant
- Autosomal recessive
- X-linked recessive
- Mitochondrial

Acquired:
- Perinatal Brain injury
- Infection
- Drug
- Toxic
- Vascular
- Neoplastic
- Brain Injury
- Psychogenic

Idiopathic:
- Sporadic
- Familial

Table 1

problems, e.g. dystonia in a child's legs may help compensate for significant muscle weakness and help to maintain an upright posture.

Reduced joint range and musculoskeletal deformities must also be considered when approaching the child with dystonia, Persistent abnormal muscle contractions can results in contractures – a permanent shorting of the muscle or joint which only orthopaedic intervention can improve. Contractures in the lower limb can impact upon gait and standing, whilst upper limb contractures can affect hand function.

Pathophysiology of dystonia

Our understanding of the pathophysiology of dystonia remains incomplete. Dystonia has traditionally been considered a disorder of basal ganglia and thalamic function, due to early post-mortem studies identifying lesions in these structures in patients with dystonia. It has become appreciated that dystonia may arise as a consequence of disruption across the motor network as a whole. It is increasingly recognised that abnormalities in cerebellar function may result in dystonia, and there has been much focus on how the basal ganglia and cerebellum interact to give rise to involuntary movements. The pathophysiology of dystonia has been best studied in isolated monogenetic dystonia (previously termed "primary dystonia"). Three distinct abnormalities appear to give rise to dystonic movements:

1) A loss of normal inhibition within the nervous system
2) Abnormalities in sensory function
3) Abnormally increased plasticity within the nervous system

Intuitively, a loss of inhibition seems a natural explanation for the inability to suppress unwanted movements. Sensory abnormalities are also not unexpected, given that sensory feedback is an important part of motor learning and development. Abnormal plasticity has been suggested to lead to a strengthening of the synaptic connections involved in the expression of dystonic movements. These movement patterns become more deeply "embedded" in the motor network, reinforcing the expression of these movements. It is far from clear whether these abnormalities are present in all forms of dystonia. Arguing for this is the remarkable similarity of dystonic movements seen in children with different underlying disease conditions. Arguing against this though, genetic disorders give rise to synaptic dysfunction at the molecular level across the entire motor network, exerting an effect throughout the development and maturation of the nervous system. How could a focal lesion in just a few neurones in just one part of the motor network (e.g. following an arterial ischaemic infarction) result in the same the same disturbance in function?

Diagnosing dystonia

A diagnosis of dystonia may be made from the clinical observation of dystonic movements in the child at the bedside or in the clinic room. Once the presence of dystonia has been identified, the question for the clinician becomes: What disorder has given rise to dystonia in this particular child?

Given the ever-increasing range of disorders giving rise to dystonia in childhood, it is not possible to "screen" for all causes. Focused investigations are required which, as with all neurological disorders, are guided by a focused history, followed by careful examination of the child. Key elements of the patient history and examination are outlined in Table 3.

An approach to diagnosis the child with dystonia is outlined in Figure 1. This can be summarised as follows:

- Confirm abnormal movements/postures are due to dystonia
- Exclude Dystonic Medication Reaction, e.g. following metoclopramide administration
- If the focused history or examination suggests a specific diagnosis – send appropriate investigations for that disorder
- If no specific diagnosis is suggested. First line investigations should include MRI brain imaging, with blood and urine tests
- CSF investigations would not ordinarily be considered 1st line unless specific conditions, e.g. Glucose Transporter Type 1 Deficiency, suspected

The investigation of the child with dystonia should be undertaken by experienced secondary or tertiary level services. The main role of the primary care team is in recognising when the disorder is present, and excluding a dystonic medication reaction. For children with suspected monogenetic dystonias, identifying

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