Chapter 11

Dysphagia in Dystonia

Carlos Henrique Ferreira Camargo, Edna Márcia da Silva Abdulmassih, Rosane Sampaio Santos and Hélio Afonso Ghizoni Teive

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1. Introduction

The word *dystonia* comes from the modern Latin *dys-* and the Greek *tonos* [1,2]. It is defined as a state of disordered tonicity, especially of muscle tissue. The word tone itself has musical connotations. It derives from the thirteeth-century old French *ton*, of the voice. The Latin word *tonus* meant a stretching, quality of sound, tone, or accent and in turn is derived from the Greek *tonos*, similarly translated as stretching, tension and raising of the voice and pitch. In modern usage, the word dystonic is applied to abnormal tension resulting in abnormal postures present in many disorders [2]. The definition of dystonia was recently revisited. In 2013, an international consensus committee proposed the following revised definition: *Dystonia is a movement disorder characterized by sustained or intermittent muscle contractions causing abnormal, often repetitive, movements, postures, or both. Dystonic movements are typically patterned, twisting, and may be tremulous. Dystonia is often initiated or worsened by voluntary action and associated with overflow muscle activation* [3].

The condition affects most voluntary muscles and is known as cervical dystonia (CD) when the neck muscles are affected. The term spasmodic torticollis was previously used for this syndrome, but it does not stress the dystonic nature of the disease [4]. Oromandibular dystonia (OMD) spasms of the masticatory, facial and lingual muscles result in repetitive and sometimes sustained jaw opening, closure, deviation or any combination of these, as well as abnormal tongue movements [5].

Various studies have shown that before treatment is started, some focal craniocervical dystonias such as spasmodic dysphonia and CD can be accompanied by a range of swallowing difficulties [6-15]. The incidence of dysphagia varies between 22 and 100 % of CD patients and is usually over 50 %. It increases significantly after botulinum toxin (BoNT) injection [8,11,12]. Dysphagia is suspected in 36 % of patients with CD on the basis of clinical assessment, and

the incidence increases to 72 % on electrophysiological evaluation of oropharyngeal swallowing and after selective rhizotomy [8,9]. Similarly, dysphagia in patients with spasmodic dysphonia has been reported before and after treatment of this condition [13-15]. Because of the anatomical distribution of the affected muscles, OMD and co-existing oral-buccal-lingual (OBL) dyskinesias are associated with abnormal perioral, oral and lingual movements that can interfere with tasks such as chewing, swallowing and speaking, leading to social embarrassment and even eating disorders and weight loss. Eating dysfunction has been reported in 15.6 % of OMD cases [16]. Pharyngeal OMD often affects the pharyngeal constrictor muscles and can occur with spasmodic dysphonia. Choking and difficulty in swallowing are common complaints. After treatment of spasmodic dysphonia, there may be an unexpected improvement in pharyngeal dystonia. Treatment for pharyngeal constriction muscle dysfunction is nearly always associated with dysphagia [17].

Although new radiologic changes were observed in 50 % of CD patients following BoNT-A treatment, clinically only 33 % of the patients reported new dysphagia symptoms. The severity of the new dysphagia symptoms correlated strongly with the severity of new radiologic pharyngeal abnormalities [8].

In this chapter the role of dysphagia as a clinical symptom of cranio-cervical dystonia is discussed and the occurrence of dysphagia as a common adverse effect of treatment for dystonias is described.

2. Classification of dystonias

If defining dystonia is difficult and controversial, classifying the various forms of dystonias is a much more complex task, primarily because the term dystonia can mean not only a disease but also a symptom that can be part of many disorders with a wide range of causes. In an attempt to clarify the term, three “surnames” for dystonia were proposed: “symptom”, “movement” and “disorder”. A patient may complain of dystonia if, for example, he has a twisted neck. The patient has a dystonia symptom (dystonia^{Sx}). On examination, the signs of dystonia may be confirmed. This patient then has a dystonia movement (dystonia^{Mov}). Finally, dystonia as a disorder (dystonia^{Dx}) requires a clinicopathologic understanding of the etiology of the disease, i.e., whether it is genetic, late-onset, post-traumatic, or has other etiologies [18]. These new definitions led to the replacement of the 1998 dystonia classification [3] by a new one in 2013. The dystonias are now subdivided according to whether they are the result of pathological changes or structural damage, have acquired causes or are hereditary. If there is no clearly defined etiology, the dystonia can be classified as idiopathic familial or idiopathic sporadic [3].

Recent years have seen significant progress being made in our understanding of the genetics of dystonias as new loci and genes have been identified. For generalized dystonias, the genetic mechanisms are better understood, while for focal dystonias, the genes and genetic susceptibility to the disorder are not yet well identified. Hereditary dystonias (dystonia^{Dx}) are clinically and genetically heterogeneous. The known genetic forms include all monogenic inheritance

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patterns (autosomal recessive, autosomal dominant, and X-linked). Table 1 shows the hereditary dystonias grouped according to their similarities. They are divided according to their clinical features (axis I) and etiology (axis II) in line with the new 2013 classification.

3. Phenomenology and clinical features of cranio-cervical dystonias

3.1. Blepharospasm

Blepharospasm (BSP) is a form of focal dystonia characterized clinically by involuntary periocular spasms resulting in forceful eye closure [20,21,22]. BSP is characterized by tonic, phasic or combined involuntary tonic-phasic contractions of the orbicularis oculi muscles, producing repeated and frequent blinking and persistent forceful closure of the eyelids with various degrees of functional blindness. The characteristic features of BSP include sensory tricks that patients use to relieve their symptoms (geste antagoniste) and a high frequency of ocular symptoms starting before or at the onset of the spasm [20,21,22]. BSP may be associated with inhibition of the levator palpebrae muscle (apraxia of eyelid opening) or involuntary movements in the lower face or jaw muscles [20,21,22]. Apraxia of eyelid opening may in turn be associated with other neurological conditions, such as progressive supranuclear palsy and corticobasal degeneration [21,22].

3.2. Oromandibular dystonia

OMD refers to involuntary spasms of masticatory, lingual, and pharyngeal muscles that result in jaw closing (JC), jaw opening (JO), jaw deviation (JD), or a combination of these abnormal movements [22,23]. When OMD is associated with blepharospasm, the combination is referred to as "cranial dystonia" or, less appropriately, as "Meige's syndrome" [24]. Because of the anatomical distribution of the affected muscles, OMD and co-existing OBL dyskinesias are associated with abnormal perioral, oral and lingual movements that can interfere with chewing, swallowing and speaking, leading to social embarrassment [25] and even eating disorders and weight loss [26]. Examination may reveal a variety of antagonistic maneuvers, or sensory tricks, including touching the lips or chin, chewing gum, or biting on a toothpick [21]. Even using these sensory tricks, patients often feel socially embarrassed by the spasms, which give them a disfigured appearance [22].

3.3. Lingual dystonia

Dystonic involvement of the tongue is a well-recognized feature of tardive dystonia as well as OMD, both primary and secondary, although primary focal lingual dystonia (PFLD) has only rarely been described. PFLD presents as an action dystonia during speech or in paroxysmal episodic lingual dystonic spasms [27]. A rare disorder, it can be severe enough to affect speech, swallowing and breathing. Tardive lingual dystonia secondary to dopamine-receptor-blocking drugs may manifest as a relatively isolated problem. Although severe tongue protrusion, particularly during eating, is characteristic of neuroacanthocytosis, it can also be

seen in other rare forms of symptomatic dystonias such as pantothenate kinase-associated neurodegeneration and Lesch–Nyhan syndrome [21].

3.4. Laryngeal dystonia

Laryngeal dystonia (spasmodic dysphonia) is a neurological voice disorder with low prevalence. It is characterized by involuntary adductor (toward the midline) or abductor (away from the midline) vocal fold spasms during phonation that cause phonatory breaks [20,22]. Some patients also present with a mixed type of this disorder. Onset of laryngeal dystonia frequently occurs late in life and presents in mild to severely disabling forms that lead to long-lasting impaired verbal communication. Adductor spasmodic dysphonia (SD) is undoubtedly the most common form [22]. Both forms rarely occur in the same individual. Around one-third of SD sufferers also present with voice tremor, which makes the pitch and loudness of the voice waver at 5 Hz during vowels and is most apparent when the sound "/a/" (as in "all") is produced for at least 5 s [28].

3.5. Cervical dystonia

CD is characterized by involuntary posturing of the head as a result of involuntary spasms, jerks, or tremors (or a combination of all three) and is often associated with neck pain. Clinical classification is based on the position of the head and type of movement. The most common form is rotational torticollis (>50 %). Other relatively frequent forms include laterocollis and retrocollis, while anterocollis and complex forms of CD (in which there is no predominant component) are less common. Patients frequently present with a combination of abnormal patterns, even when it is possible to identify a predominant component [29]. A number of sensory tricks, including touching the contralateral side of the face as well as ipsilateral to the direction of head rotation, can produce a temporary improvement in involuntary neck movements. As with other forms of focal dystonia, the symptoms of CD are exacerbated by stress and improved by relaxation [20,29].

Clinical category	Designation	Clinical characteristics	Locus	Gene	Inheritance pattern
Isolated dystonias					
Persistent dystonias					
Childhood- or adolescent-onset dystonias	DYT1	Early-onset primary generalized dystonia	9q	*TOR1-A or DYT1*	AD
	DYT2	Autosomal recessive idiopathic dystonia	-	-	AR
	DYT6	Mixed dystonia	8p	*THAP1* or DYT6	AD
	DYT13	Early-onset primary segmental craniocervical dystonia	1p	-	AD

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Clinical category	Designation	Clinical characteristics	Locus	Gene	Inheritance pattern
	DYT17	Idiopathic autosomal recessive primary dystonia	20pq	-	AR
Adult-onset dystonias	DYT7	Adult-onset focal dystonia	18p	-	AD
	DYT21	Late-onset autosomal dominant focal dystonia	2q	-	AD
	DYT23	Adult-onset primary cervical dystonia	9q	*CIZ1*	AD
	DYT24	Autosomal dominant craniocervical dystonia	11p	*ANO3*	AD
	DYT25	Late-onset autosomal dominant primary focal dystonia	18p	*GNAL*	AD
Combined dystonias					
Persistent dystonias					
Dystonias with parkinsonism					
Without any evidence of degeneration	DYT5	Dopa-responsive dystonia or Segawa dystonia	14q/1p	*GCH1 and TH*	AD and AR
	DYT12	Rapid-onset dystonia parkinsonism	19q	*ATP1A3*	AD
	DYT16	Adolescent-onset dystonia parkinsonism	2p	*PRKRA or DYT16*	AR
With evidence of degeneration	DYT3	X-linked dystonia-parkinsonism or lubag	Xq	*TAF1 or DYT3*	XR
Dystonias with myoclonus	DYT11	Myoclonus-dystonia	7q	-	AD
	DYT15	Myoclonus-dystonia	18p	*SGCE*	AD
Dystonias with chorea	DYT4	Dystonia with whispering dysphonia	19p	*TUBB4*	AD
Paroxysmal dystonias					
Paroxysmal dyskinesias	DYT8	Paroxysmal nonkinesigenic dyskinesia 1	2q	*MR-1*	AD

Clinical category	Designation	Clinical characteristics	Locus	Gene	Inheritance pattern
	DYT20	Paroxysmal nonkinesigenic dyskinesia 2	2q	-	AD
	DYT10	Paroxysmal kinesigenic dyskinesia 1	16pq	*PRRT2*	AD
	DYT19	Paroxysmal kinesigenic dyskinesia 2	16q	-	AD
	DYT18	Exercise-induced paroxysmal dyskinesia	1p	*SLC2A1* or GLUT1	AD

*Based on Albanese et al. [3] and Lohmann and Klein [19]

AD – Autosomal dominant, AR – Autosomal recessive, XR – X-linked recessive

Table 1. The hereditary dystonias *

4. Treatment of craniocervical dystonias with BoNT

While BoNT treatment remains the treatment of preference for most focal dystonias, pharmacological and neurosurgical treatments are also important in the treatment algorithm. Treatment with BoNT in properly adjusted doses is known to be effective and safe for cranial and cervical dystonia, but not OMD. In recent years, long-term studies on the efficacy and safety of BoNT-A have been published, a new BoNT-A formulation has been marketed and new studies on BoNT-B have been carried out [30]. Systematic reviews and guidelines recommend that BoNT injections should be offered as a treatment option for CD (for which it has been proven to be effective) and can be offered for blepharospasm, focal upper extremity dystonia and adductor laryngeal dystonia (for which it is probably effective) [30,31].

The first study on the use of BoNT for CD was a single-blind study with 12 patients and used electromyography guidance and a total maximum BoNT-A dose of 200 U (then called Oculinum®) (Smith-Kettlewell Institute, San Francisco, CA, USA). Improvements lasting 4 to 8 weeks were observed in 92 % of the patients, and 25 % reported transient neck weakness [32]. These early results were confirmed by a double-blind, placebo-controlled crossover study of 21 patients using 100 U of BoNT-A which showed an improvement based on investigator ratings and patient assessment of CD severity [33]. Since then some 80 studies have evaluated BoNT in CD. Table 2 shows the main results of some studies. Adverse events included dysphagia and neck weakness [29, 33-38].

While some forms of dystonia are relatively common, such as adult-onset CD, others are less frequent, and not all clinicians have enough clinical experience to guide their practice [39]. OMD is a type of focal dystonia that affects the lower facial, masticatory, labial and lingual musculature. When OMD occurs with blepharospasm, the term cranial dystonia is used.

Meige's syndrome, a variant of OMD, is a combination of upper and lower facial motor dysfunction that includes blepharospasm and OMD [40]. Isolated OMD is relatively rare and represents only 5 % of all dystonias. However, cranial dystonias (OMD, blepharospasm and Meige's syndrome) are the second most frequent dystonias (22 %) [40, 41].

Dystonia is not a stereotyped disorder, and in OMD it has a highly variable presentation. Consequently, treatment must be individualized to accommodate the patients particular requirements and symptoms. OMD dystonia can be classified into the following types: JC, JO, JD, lingual, pharyngeal and mixed [41]. BoNT has become the therapy of choice for OMD, and its use in JO, JC, and JD OMD has been well documented. Although most of the reported literature on OMD consists of open studies, all these have reported improvement with BoNT. In general, JO dystonia is more difficult to treat than JC dystonia [41,42].

	Dose (U)	Motor	Pain improvement
Tsui et al. 1986[33]	100	63 %	87 %
Gelb et al. 1989[34]	50-280	80 %	50 %
Jankovic and Schwartz, 1990[35]	100-300	70.7 %	76.4 %
Greene et al. 1990[36]	30-250	74 %	-
Jankovic et al., 1990[37]	209 (average)	90 %	93 %
Kwan et al. 1998[38]	190	70 %	-
Camargo et al. 2008[29]	100-280 (151.05±52.55)	94.1 %	84.4 %

Table 2. Studies with botulinum toxin A (BOTOX®) for cervical dystonia

5. Diagnosis of dysphagia in dystonias

As it is not easy for patients with CD to notice dysphagia, this condition is very often under-diagnosed [6,29].

Oropharyngeal function is usually investigated with the aid of videofluoroscopy. Clinical and videofluoroscopic evaluations have also indicated a high incidence of swallowing disorders in patients with CD before any treatment such as BoNT injection or rhizotomy [7-9]. In one study, swallowing abnormalities during video fluoroscopic examination were observed in over 50 % of CD patients [7].

In general, videofluoroscopic studies of CD patients show delayed initiation of swallowing and pharyngeal residue [7,10]. CD patients with these signs appear to have "neurogenic dysphagia" [7,43]. In contrast, asymmetric pharyngeal transit of large liquid boluses is consistent with tonic or clonic posturing of the head (and pharynx). Although the postural and neurogenic signs presumably relate to the same underlying neurologic dysfunction and both

types might be considered "neurogenic," the authors of some studies suggest that the postural signs were sufficiently selective and specific to warrant a separate classification [7]. Therefore, Riski et al. [7] considered the presence of pharyngeal asymmetry with large boluses to be a sign of "postural dysphagia." Of 43 patients, 16 showed only neurologic signs; three showed only postural signs; and three showed combined postural and neurologic signs. The findings of Riski et al. suggest that swallowing abnormalities in CD are primarily neurogenic but may be solely postural or combined neurogenic and postural in nature. In agreement with this conclusion that CD involves neurogenic dysphagia, similar clinical and electrophysiological findings were reported in patients with OMD and laryngeal dystonia but not CD and in others with CD. Therefore, dysphagia can occur without abnormal head or neck movements [6]. Electrophysiological abnormalities in dystonic muscles are frequent and are all compatible with neurogenic dysphagia [6].

Two-thirds of those who complained of dysphagia showed evidence of swallowing abnormalities, and at least one swallowing abnormality was detected radiographically in half of those who did not complain. This lack of close agreement between subjective reports and videofluoroscopic results may reflect several factors. Firstly, videofluoroscopic examination of swallowing can show dysfunctions; however, as the protocol is standardized, it does not simulate all factors present during meals in the patient's home, e.g., the full range of textures and bolus sizes, the speed of bolus presentation and the presence of external distractions. Secondly, some patients' concerns with the discomfort or cosmetic disability associated with their CD may overshadow the relatively subtle abnormalities in oropharyngeal function. Thirdly, CD patients may have adapted to changes in swallowing function and therefore be asymptomatic [7].

Dysphagia and dysarthria (which account for 10.2 % to 37 % and 0.9 % of complaints, respectively) are the two most common adverse effects of BoNT treatment for OMD [37,42]. Clinical and videofluoroscopic evaluations have also indicated a high incidence of swallowing disorders in CD patients before any treatment such as BoNT injection or rhizotomy [7-9]. In a study by Comella et al., although new radiologic changes occurred in 50 % of CD patients following BoNT treatment, clinically only 33 % of these patients reported new dysphagia symptoms. The severity of new dysphagia symptoms correlated highly with the severity of new radiologic pharyngeal abnormalities. This suggests that rather than being routinely indicated, videofluoroscopic swallowing evaluations should be reserved mainly for patients with the severest clinical symptoms as an objective measure to assess the possibility of aspiration [8].

6. Avoiding dysphagia as an adverse effect of treatment for dystonia

Radiologic findings show that in patients with dysphagia prior to treatment with BoNT-A, the condition did not worsen following treatment [8].

Careful choice of the correct muscle groups with the aid of electromyography before application of BoNT and the use of low dosages may prevent adverse effects [29]. In a study by

Jankovic et al. [37], in which higher average doses of BoNT were used without electromyography guidance, 24 % of CD patients experienced adverse effects, and of these 23 % suffered from dysphagia. In a study by Barbosa et al. [43], who used an average dose of 191 U and did not use electromyography, slightly under half (47 %) of the patients developed dysphagia.

Other factors may have contributed to the low dysphagia indexes found in most studies. For example, the use of a larger number of injection points in each muscle and application in only one sternocleidomastoid (thus reducing diffusion of BoNT-A to the pharynx) can reduce the incidence of dysphagia [29]. Denervation has been shown to occur within a definable area that crosses anatomic barriers, including fascia and bone. Nevertheless, clinical and laboratory data suggest that dysphagia secondary to BoNT therapy is the result of toxin spreading from the sternocleidomastoid injection site to the pharyngeal musculature. Ensuring the injection dose in the sternomastoid does not exceed 100 IU leads to a substantially reduced incidence of this complication [12].

7. Conclusion

Dystonia is an important cause of dysphagia. The main aspects to observe in dystonic patients are:

1. Patients do not normally complain of dysphagia. Comprehensive questioning to confirm this symptom is therefore essential. When indicated, a search for dysphagia in dystonic patients should be performed with videofluoroscopy.
2. Optimization of treatment with BoNT (administration of the lowest possible dose, the use of electromyography and the appropriate choice of muscles) can avoid dysphagia.

Author details

Carlos Henrique Ferreira Camargo[1,2*], Edna Márcia da Silva Abdulmassih[3], Rosane Sampaio Santos[4] and Hélio Afonso Ghizoni Teive[3]

*Address all correspondence to: chcamargo@uol.com.br

1 Department of Medicine, State University of Ponta Grossa, Brazil

2 Hospital Universitário dos Campos Gerais, State University of Ponta Grossa, Brazil

3 Hospital de Clínicas, Federal University of Parana, Brazil

4 Tuiuti University of Parana, Brazil

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