Muscle Tension Dysphonia: Which Laryngoscopic Features Can We Rely on for Diagnosis?

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Summary: Objectives. Muscle tension dysphonia (MTD) is generally diagnosed through clinical history and physical examination. Several diagnostic or classification systems exist, such as those of Van Lawrence, Morrison-Rammage, and Koufman, that delineate MTD and distinguish subtypes on the basis of laryngoscopic features. The aim of this study is to determine which of the clinical features included in these classifications are most related to the aerodynamic profile of MTD.

Study design. This is an analytic retrospective study.

Material and methods. This study evaluates a series of 30 consecutive patients, all over 18 years old, who attended the voice clinic consult of our department and were diagnosed with MTD. All subjects underwent fiberoptic nasal endoscopy, acoustic voice assessment, and aerodynamic voice assessment. The study only includes patients with a pathological aerodynamic profile. Presence or absence of each laryngoscopic feature in the full range of features in the Van Lawrence, Morrison-Rammage, and Koufman classification systems was evaluated independently by three experts. Cohen's kappa coefficient was calculated to indicate the degree of concordance between the experts. The chi-squared test was used to determine the degree of association between clinical features and mean value of the subglottic pressure peak (mmH_2O).

Results. Clinical parameters that were found to have a statistically significant association ($P < 0.05$) with an alteration in mean subglottic pressure peak were those related to anteroposterior and lateral compression of the larynx in Van Lawrence, Morrison-Rammage, and Koufman classification systems.

Conclusions. While several studies have sought to clarify the laryngoscopic features of MTD, the current study is the first to evaluate these features in subjects who have been objectively diagnosed by means of aerodynamic voice assessment. The laryngoscopic features most strongly related to an aerodynamic profile of MTD were anteroposterior compression of the larynx, lateral compression of the larynx, and vestibular fold contribution to phonation.

Key Words: Muscle tension dysphonia−Functional dysphonia−Videolaryngoscopy−Aerodynamics−Hyperfunction.

INTRODUCTION

Muscle tension dysphonia (MTD) is a functional voice disorder first described by Morrison et al in 1983[1] as a pathological condition in which an excessive tension of the extrinsic laryngeal musculature during phonation, caused by a diverse number of etiological factors, leads to an altered position of the larynx in the neck and a disturbed inclination of the cartilaginous structures that affect the intrinsic musculature and the tension of the vocal folds, giving rise to a disturbed voice.[1,2] When there are no underlying structural or neurologic abnormalities, the MTD is denominated primary; when the MTD is a compensatory reaction to another condition affecting the voice, it is referred to as secondary.[3] It is not fully understood yet whether MTD leads to organic pathology or MTD is the result of organic lesions. Besides altered voice quality, MTD is sometimes associated with a sensation of dryness, tickling, irritation, or obstruction in the throat.[4] Approximately 40%−70% of dysphonic patients presenting to a voice clinic have no organic or mucosal disease, also MTD justifies most of clinic caseloads[5] and it has an impact on social and occupational functioning.[3] Voice problems and these various forms of physical discomfort are reported more by women than by men.[6]

The diagnosis of MTD is mostly made on the basis of fibrolaryngoscopic features and clinical history. To this end, there are several diagnostic or classification systems that make use of solely clinical profiles to help diagnose MTD and MTD subtypes. Three of the most important such classifications and the most used are those of Koufman, Van Lawrence and Morrison-Rammage.[5,7,8] There is no internationally accepted classification system and some of the terms used in the different classifications are confusing or describe the same clinical pattern with a different name. Studies have been carried out to determine which clinical features are specific to patients with MTD and which features or sets of features correlate most strongly with the disorder.[9,10] In all of these studies, however, the ground truth diagnosis of MTD was itself established clinically.

Over the past few years, aerodynamic voice analysis has been taken into account for a better understanding and an objective approach to this voice disorder.[11] Espinoza et al[12] described that glottal aerodynamic measures (subglottal pressure) in patients with MTD were different from those with normal voices. Also, Gillespie et al,[3] in a study in women with MTD, concluded that aerodynamic profiles were significantly different as compared with healthy speakers, with the most common aerodynamic profile in patients with MTD being high subglottic pressure in combination with normal or high phonation airflow. Zheng et al[13] concluded through a

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multivariate logistic regression that subglottal pressure and maximum phonation time could correctly classify MTD with 92.5% accuracy, indicating that an aerodynamic evaluation can be used to objectively diagnose MTD. Furthermore, aerodynamic analysis has also been used for treatment efficacy evaluation in patients with MTD evaluating the vocal functional status before and after treatment.[14]

The use of quantitative-objective measurements of voice parameters has demonstrated to be crucial in the assessment of voice pathology including MTD[15]; nevertheless, an aerodynamic voice assessment is not available to all otorhinolaryngologists or it is not considered necessary or appropriate to be used on all patients. The aim of the current study is to determine which are the clinical features more related to an abnormal aerodynamic parameter of MTD. We describe a retrospective, cross-sectional study of the clinical features of the Van Lawrence, Morrison-Rammage, and Koufman classifications in a population of patients with a diagnosis of MTD based on an objective technique as is the aerodynamic voice analysis.

MATERIAL AND METHODS

The study evaluates a series of 30 consecutive patients, all over 18 years old, who attended the voice clinic consult of our department, and were diagnosed with MTD and who met the following criteria: dysphonia for more than 3 months; absence of evidence of underlying structural abnormalities, including those related to presbiphonia; absence of neurologic abnormalities; and an altered aerodynamic profile characterized by high subglottic pressure with normal or high phonation airflow. In addition, acoustic voice assessment measurements were available for all patients.

Clinical features

Fiberoptic nasal endoscopy was performed using a Video Naso-Pharyngo-Laryngoscope Pentax VNL-1070STK (PENTAX Europe GmbH, Hamburg, Germany) and recorded during clinical examination while the patient carried out different phonatory tasks, such as sustained articulation of the vowel /i/ and breathing slowly. The video was later analyzed separately by three experts, who scored the presence or absence of the six features in the Van Lawrence classification system, the six features in that of Morrison-Rammage, and the four features in that of Koufman. Cohen's kappa coefficient was calculated to indicate the degree of concordance between the three evaluators.

Aerodynamic voice assessment

An aerodynamic profile was obtained by means of a Rothemberg mask adapted for connection to a pneumotachograph and differential pressure transducers (PTL-1 for oral pressure and PTW-1 for oral flow, Glottal Enterprises, Syracuse, NY). The parameters studied were mean value of the subglottic pressure peak (mmH_2O), mean vocal tract transglottic flow (l/s), laryngeal resistance (mmH_2O l/s), maximum phonation time, maximum expiration time (s), s/z index, and phonorespiratory quotient.

Acoustic voice assessment

For acoustic analysis, we used *SoundScope software* (GW Instruments, Inc. Somerville, MA). Recordings were made with an electret microphone positioned 30 cm away from the lips of the patient. The values studied were fundamental frequency (Hz), jitter (%), shimmer (%), and harmonic-to-noise ratio (dB). Spectrums in the time domain were created with a narrow (45 Hz) band-pass filter.

Statistical analysis

A chi-squared test was used to determine the degree of association between clinical features and mean subglottic pressure peak. A value of $P < 0.05$ was regarded as being statistically significant.

RESULTS

The mean age of the patients was 50 years (range 21−82 years). There were 18 women and 12 men. The aerodynamic analysis, acoustic voice analysis, and Yanagihara grades of the patients are represented in Table 1. The degree of concordance between evaluators was good for Van Lawrence and Morrison-Rammage classification and very good for MTD by Koufman (Table 2). Clinical parameters that were found to have a

TABLE 1.
Mean Values and Standard Deviation of Aerodynamic Parameters, Acoustic Parameters (Divided by Sex), and Number of Patients According to Yanagihara Classification of Spectrographic Characteristics

Aerodynamic Voice Assessment	Mean ± SD
Laryngeal resistance (mmH_2O l/s)	1534.10 ± 314
Mean vocal tract transglottic flow (l/s)	0.14 ± 0.05
Subglottic pressure peak (mmH_2O)	108.2 ± 9.7
Acoustic Voice Assessment	
Men (12)	
Fundamental frequency (Hz)	143 ± 23
Maximum frequency (i)	236 ± 19
Minimum frequency (i)	163 ± 19
Jitter (%) (i)	1083 ± 0.18
Shimmer (%) (i)	4341 ± 0.89
Women (18)	
Fundamental frequency (Hz)	224 ± 25
Maximum frequency (i)	392 ± 18
Minimum frequency (i)	159 ± 19
Jitter (%) (i)	0.93 ± 0.14
Shimmer (%) (i)	3.11 ± 0.61
Yanagihara Grades	**N**
0	1
I	15
II	11
III	3
IV	0

Abbreviations: SD, standard deviation; N, number of patients.

TABLE 2.
Inter-rater agreement for qualitative or categorical items for the main MTD classification systems

		Van Lawrence	Morrison-Rammage	MDT by Koufman	*P* Value
Cohen's kappa coefficient		0.78	0.78	0.86	
VL: Harsh approximation of arytenoids and poor "pointed arc"		VL1			ns
VL: Minimal vocal cord length visibility MDT: Complete supraglottic closure of the larynx ("sphincteric larynx")		VL2		4MDT	ns
VL: Vestibular fold contribution to phonation MR: Lateral hyperadduction state: Supra-Glottic MDT: Approximation of the false vocal cords ("false vocal cord voice")		VL3	MR2b	2MDT	0.03
VL: Excessive vertical movement of larynx		VL4			ns
VL: Anteroposterior compression of larynx MR: Supraglottic anteroposterior contraction MDT: Partial anteroposterior contraction of the supraglottis ("anteroposterior contraction")		VL5	MR3	3MDT	0.02
VL: Lateral compression of larynx MR: Lateral hyperadduction state: Glottic		VL6	MR2a		0.02
MR: The laryngeal isometric MDT: Open posterior commissure ("laryngeal isometric")			MR1	1MDT	ns
MR: Conversion aphonia			MR4		ns
MR: Psychogenic bowing			MR5		ns

Notes: The first row shows the concordance value between the evaluators for each classification system. The last column on the right shows the degree of association between clinical features and mean subglottic pressure peak using a chi-squared test.
MTD type 6 of Morrison-Rammage: Adolescent transitional dysphonia was not included in the study.
Abbreviations: VL, Van Lawrence; MR, Morrison-Rammage; MDT, MTD by Koufman; ns, nonsignificant.

statistically significant association with an alteration in mean subglottic pressure peak were Van Lawrence features VL3, VL5, and VL6; Morrison-Rammage features MR2a, MR2b, and MR3; and Koufman features MTD2, MTD3, andMTD4 (Table 2).

DISCUSSION

This is the first study to analyze the relationship between the laryngoscopically observed features used in the commonly cited clinical diagnosis/classification systems of Van Lawrence, Morrison-Rammage, and Koufman, with an aerodynamic profile of patients with MTD. In all of the patients studied, there was at least one laryngoscopic MTD feature—at least one in each of the three classification systems—that was recognized as being present by all three evaluators.

Laryngoscopic features commonly associated with MDT are prevalent in the nondysphonic population and sometimes fail to distinguish patients with MTD from normal subjects.[9,10] If a solid diagnosis cannot be established and aerodynamic voice assessment is not possible, a careful review of a patient's clinical history can often be useful, and this highlights the importance of being meticulous in the follow-up of patients with dysphonia.

Unlike some clinical features, the aerodynamic profile of a patient with MTD differs from that of a nondysphonic person.[13] Only subjects with a pathological aerodynamic profile (high subglottic pressure with normal or high phonation transglottal airflow) were included in our study. Subglottic pressure refers to the lung pressure reaching the subglottic airway, which is one of the most common indicators in an aerodynamic voice analysis.[16] It is an assumption underlying this study that the various laryngoscopic features observed to be correlated with high subglottic pressure are pathological.

An extensive review of the literature related to the clinical features of MTD reveals various areas of confusion as a result of multiple terms referring to the same thing, subjectivity, and lack of precision in definitions and terminology. The following are some examples. Laryngeal isometry is often referred to as opening in the posterior glottis. Laryngeal sphincter is often known as complete anteroposterior contraction. Conversion aphonia, which is referred to in the Morrison classification (MR4), was originally described as involving full movement of the vocal folds for cough or other types of vegetative phonation but with insufficient adduction for voicing. Later descriptions, however, include incomplete adduction of the vocal cords,[9] posterior hiatus,[10] or anteroposterior compression combined with lateral contracture.[17] Similarly, laryngeal isometry (MR1) was initially described as a persistent pull of the posterior cricoarytenoid muscle during phonation, creating a posterior glottal chink; such an opening in the posterior glottis has later been referred to as a longitudinal hiatus.[10] Morrison's and Rammage's indeterminate adolescent transitional dysphonia has simply been omitted by some authors.[9,17] Psychogenic dysphonia with bowed vocal cords is included in the Morrison and Rammage classification, but vocal fold bowing has since been related, by Belafsky,[18] to an underlying glottal insufficiency, and consequently some authors replace the original feature with a reference to Morrison and Rammage modified by Belafsky.[17]

In addition, certain clinical features in MTD are difficult to interpret or not objective or not objectively gradable. For example, what degree of approximation of the arytenoids should be considered pathological? How much is minimal when referring to minimal vocal cord length visibility? It is the authors' view that review and selection of the relevant clinical diagnostic features of MTD and a corresponding simplification and clarification of terminology would be useful.

Sama et al[9] studied clinical features in a population of patients with clinically diagnosed MTD and concluded that the most common Van Lawrence features were approximation of arytenoids, decrease in the length of vocal cords visible, excessive vertical movement, and anteroposterior compression. The most common of the Morrison-Rammage criteria were laryngeal isometry and lateral supraglottic pressure (lateral contraction). Our results are in agreement to those of Sama et al with regard to the frequency of anteroposterior compression and lateral contraction. It may be relevant to note that these are the only two clinical features present in all of the three classification systems considered in our study.

Although we did not find either approximation of arytenoids (Van Lawrence) or larynx isometry (Morrison-Rammage) to be clearly associated with a pathological aerodynamic profile, we concur with Sama et al that these two clinical features should, like anteroposterior compression and lateral contraction, be taken into account when diagnosing dysphonia and possible MTD.

CONCLUSIONS

Several authors have previously determined the laryngoscopic features most commonly associated with clinically diagnosed MTD. The current study develops on previous research by evaluating laryngoscopic features in subjects with MTD that had been objectively diagnosed by means of aerodynamic voice assessment. The laryngoscopic features most strongly related to an aerodynamic profile of MDT were vestibular fold contribution to phonation, anteroposterior compression of the larynx, and lateral compression of the larynx. These results, by elucidating a reduced number of strictly relevant laryngoscopic features, may be useful in the development of a less subjective and more straightforward classification system for diagnosing and distinguishing subtypes of MTD.

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