Voice Disorders: Etiology and Diagnosis

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Summary: Objectives. Voice disorders affect adults and children and have different causes in different age groups. The aim of the study is to present the etiology and diagnosis dysphonia in a large population of patients with this voice disorder.for dysphonia of a large population of dysphonic patients.

Methods. We evaluated 2019 patients with dysphonia who attended the Voice Disease ambulatories of a university hospital. Parameters assessed were age, gender, profession, associated symptoms, smoking, and videolaryngoscopy diagnoses.

Results. Of the 2019 patients with dysphonia who were included in this study, 786 were male (38.93%) and 1233 were female (61.07). The age groups were as follows: 1–6 years ($n = 100$); 7–12 years ($n = 187$); 13–18 years ($n = 92$); 19–39 years ($n = 494$); 41–60 years ($n = 811$); and >60 years ($n = 335$). Symptoms associated with dysphonia were vocal overuse ($n = 677$), gastroesophageal symptoms ($n = 535$), and nasosinusal symptoms ($n = 497$). The predominant professions of the patients were domestic workers, students, and teachers. Smoking was reported by 13.6% patients. With regard to the etiology of dysphonia, in children (1–18 years old), nodules ($n = 225$; 59.3%), cysts ($n = 39$; 10.3%), and acute laryngitis ($n = 26$; 6.8%) prevailed. In adults (19–60 years old), functional dysphonia ($n = 268$; 20.5%), acid laryngitis ($n = 164$; 12.5%), and vocal polyps ($n = 156$; 12%) predominated. In patients older than 60 years, presbyphonia ($n = 89$; 26.5%), functional dysphonia ($n = 59$; 17.6%), and Reinke's edema ($n = 48$; 14%) predominated.

Conclusions. In this population of 2019 patients with dysphonia, adults and women were predominant. Dysphonia had different etiologies in the age groups studied. Nodules and cysts were predominant in children, functional dysphonia and reflux in adults, and presbyphonia and Reinke's edema in the elderly.

Key Words: Dysphonia–Voice disorders–Etiology–Epidemiology–Hoarseness.

INTRODUCTION

About 10% of the general population presents with voice disorders, and among voice professionals, the proportion reaches 50%.[1–3] Children and adults are equally affected; however, the causes are different according to the age groups.

In early childhood, a frequent cause of dysphonia is acute viral laryngitis. The infection may progress to the trachea affecting the tracheobronchial tree. The manifestations are usually self-limited and rarely progress into bacterial laryngotracheal bronchitis.[4] In children older than 4 years, vocal nodules predominate among the causes for dysphonia. These lesions are phonotraumatic, directly related to vocal overuse. The peak incidence is between 5 and 10 years, mostly in boys, receding after adolescence.[4–7] The treatment of choice is voice therapy.[8]

The second cause of dysphonia in childhood is vocal cyst. Cysts are classified as epidermal or mucosal. Epidermal cysts are congenital and may be attached to the vocal ligament, worsening voicing even more. The intensity of voice involvement is related to the size of the cyst, requiring, in many cases, surgical removal.[9,10]

Laryngeal papillomatosis is also frequent in children and accompanied by progressive dysphonia and respiratory discomfort.[11] Verrucous lesions implant in the vocal cords and may involve also the supraglottic or the subglottic region and the trachea. Lesions of laryngeal papillomatosis are always recurring and they need repeated surgical removal. Adjuvant treatment with intralesional cidofovir has proved efficient; however, most authors report their experience with the drug in adults.[12] A recent systematic review that evaluated the benefits of cidofovir in the treatment of laryngeal papillomatosis included 15 randomized studies in adults and only four in children and found no difference between the drug and placebo.[13] Therefore, the benefits of cidofovir remain questionable.

Among adults, the causes of dysphonia are many, including—besides the ones previously mentioned—laryngeal trauma (mechanical, thermal, or chemical trauma); inflammations or infections (due to smoking, virus, bacteria, or reflux laryngitis); leukoplakia, endocrine, rheumatic, or neoplastic causes (benign or malignant); neurological, psychological, or emotional causes; and medication. Cancer of the vocal folds is an important cause of dysphonia in patients who smoke; videolaryngoscopy is mandatory in all smoking patients with vocal symptoms for longer than 15 days. This topic deserves a special article and will not be discussed in this paper. Other important causes of dysphonia in adults include papilloma, cysts, hemangioma, sulcus, vocal polyps, and Reinke's edema.[14–17]

Even though the literature presents many publications with epidemiologic data on dysphonia, few studies analyze large populations of adults, children, and elderly patients with this voice disorder. Additionally, rare diagnoses such as vocal sulcus and mucosal bridges have little mention in studies of children with voice disorders, and have been diagnosed more often. Thus, the purpose of this study is to analyze the causes and epidemio-

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logical data of a large population of adults and children with voice disease.

METHODS

To analyze the etiology and diagnosis of dysphonia, this study included patients with voice disease who sought treatment in the ambulatory of the Botucatu Medical School between 2004 and 2014. Patients were included in the study in the chronological order of arrival at the ambulatory for voice disorders. All patients underwent videolaryngostroboscopy to confirm the diagnosis of dysphonia with a rigid telescope 70°, 8 mm (AZAP, Germany), or nasofibroscopy (3.5 mm in diameter, Olympus, Japan) and videostroboscopy(Atmos Inc., Germany). Patients diagnosed with acid laryngitis or psychogenic dysphonia were submitted to multidisciplinary assessment, including measurement of pH levels and examination by a gastroenterologist and a psychologist.

The diagnosis of presbyphonia was established in patients aged more than 60 years who showed the following having vocal symptoms: vocal fatigue, decreased vocal range, and low and breathy voice. The videolaryngoscopy of these patients did not identify organic laryngeal lesions, but showed atrophy of the vocal folds, prominence of vocal apophysis, bowed vocal folds, and vocal tremor.

All patients included in this study were evaluated by a speech pathologist.

The following parameters were analyzed: age, gender, profession, associated symptoms (vocal overuse, gastroesophageal symptoms, and nasosinusal symptoms), smoking, and laryngeal diagnoses. The project was approved by the Ethics in Research Committee of the Botucatu Medical School.

This study included only patients with predominant symptoms of dysphonia who were treated in the Voice Disease ambulatory. Only one laryngeal diagnosis was considered per patient (the most relevant); the patients with uncertain diagnoses were excluded, as well as patients with laryngeal cancer, and those treated in other sites such as the emergency department or wards. Some patients had their diagnoses confirmed during microsurgery.

The results were presented in tables and charts and submitted for statistical analyses. The chi-square test was used to compare the parameters studied, using the 5% level of significance.

RESULTS

Age group and gender

Of the 2343 medical records initially selected, 324 were excluded because they were incomplete. Thus, 2019 patients were included in the study, of which 786 were male (38.93%) and 1233 were female (61.07%), distributed in age groups as shown in Table 1. Children aged between 1 and 18 years corresponded to 18% of the population, with a predominance of boys. Of the cases, 64% were adults aged 19–60 years (472 men and 833 women), and 16% were 60 year olds or older.

TABLE 1.
Age and Gender

	Gender		
Age (Years)	Male *N*	Female *N*	Total *N* (%)
1–6	62	38	100 (4.96)
7–12	112	75	187 (9.26)
13–18	39	53	92 (4.55)
19–39	194	300	494 (24.47)
41–60	278	533	811 (40.16)
>60	101	234	335 (16.60)
Total	**786 (38.93)**	**1233 (61.07)**	**2019 (100.00)**

Note: $P < 0.0001$.

Smoking

Only 275 patients (13.62%) reported smoking, and 35 (1.70%) had stopped smoking. All of them are adults.

Associated symptoms

The associated symptoms were vocal overuse ($n = 677$; 33.53%), gastroesophageal symptoms ($n = 535$; 26.5%), and nasosinusal symptoms ($n = 497$; 24.61%).

Profession

Among the professions, domestic employees, students, and teachers were the most prominent (Table 2).

Laryngeal diagnoses

The laryngeal diagnoses are presented in Table 3 and Figures 1–6, where they appear by age group and gender. In 379 children, with ages ranging from 1 to 18 years (19%) (Figures 1–3), vocal nodules predominated, being diagnosed in 225 patients (59%), followed by vocal cysts ($n = 39$; 10.3%), and acute laryngitis ($n = 26$; 6.8%). There were 1305 adult patients aged between 19 and 60 years (64.6%) (Table 3; Figures 4–6), and among them the main laryngeal diagnoses were functional dysphonia ($n = 268$;

TABLE 2.
Profession

Profession	*N* (%)
Domestic worker	577 (28.57)
Student	351 (17.38)
Teacher	295 (14.61)
Retired	289 (14.31)
Sales person	192 (9.50)
Vendor	93 (4.60)
Singer	49 (2.43)
Nurse	18 (0.90)
Bank worker	17 (0.84)
Secretary	16 (0.80)
Preacher	14 (0.70)
Telemarketing operator	10 (0.50)
Others	98 (4.86)

Note: $P < 0.0001$.

TABLE 3.
Laryngeal Diagnoses in the Total Population in Both Genders

Laryngeal Diagnosis	Male	Female	*N* (%)	*P* Value
Functional/normal	153	193	346 (17.13)	0.03
Vocal nodules	147	199	346 (17.13)	0.005
Acid laryngitis	80	121	201 (9.96)	0.004
Reinke's edema	53	134	187 (9.26)	<0.0001
Polyp	79	101	180 (8.91)	0.1
Cyst	47	72	119 (5.90)	0.02
Paralysis	34	76	110 (5.45)	<0.0001
Presbyphonia	21	68	89 (4.40)	<0.0001
Vocal sulcus	19	53	72 (3.56)	<0.0001
Leukoplakia	54	9	63 (3.12)	<0.0001
Acute laryngitis	28	32	60 (2.98)	0.6
Psychogenic	2	49	51 (2.53)	<0.0001
Granuloma	19	28	47 (2.32)	0.19
Papillomatosis	10	20	30 (1.48)	0.07
Microvascular lesion	12	15	27 (1.34)	0.56
Vocal bridge	7	19	26 (1.29)	0.02
Nonspecific chronic laryngitis	8	16	24 (1.19)	0.1
Microweb	8	12	20 (1.00)	0.37
Dystonia	3	12	15 (0.75)	0.02
Laryngeal hemangioma	2	2	4 (0.20)	1
Laryngeal lymphangioma	0	1	1 (0.05)	0.31
Myasthenia	0	1	1 (0.05)	0.31
Total	**786**	**1233**	**2019 (100.00)**	**<0.00001**

Note: P = men × female.

20.5%), acid laryngitis ($n = 164$; 12.5%), and vocal polyps ($n = 156$; 12%). In the population older than 60 years ($n = 335$; 16%), presbyphonia ($n = 89$; 26.5%), functional dysphonia ($n = 59$; 17.6%), and Reinke's edema ($n = 48$; 14%) predominated.

DISCUSSION

This study included only dysphonic patients and confirmed the predominance of adults between the ages of 20 and 60 years (64%), and females (61%); however, in children between the ages

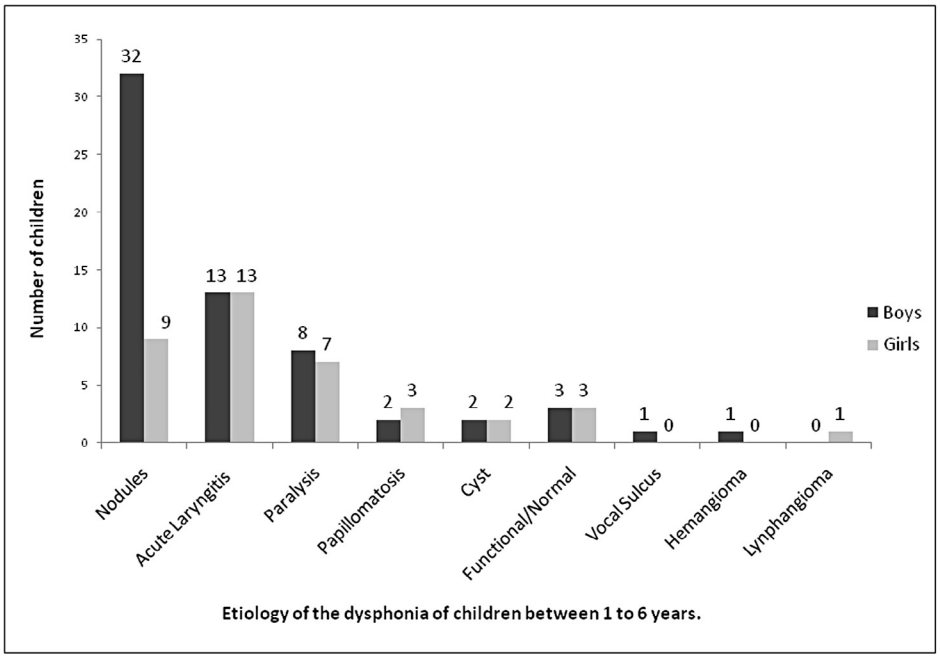

FIGURE 1. Laryngeal diagnosis of children aged between 1 and 6 years.

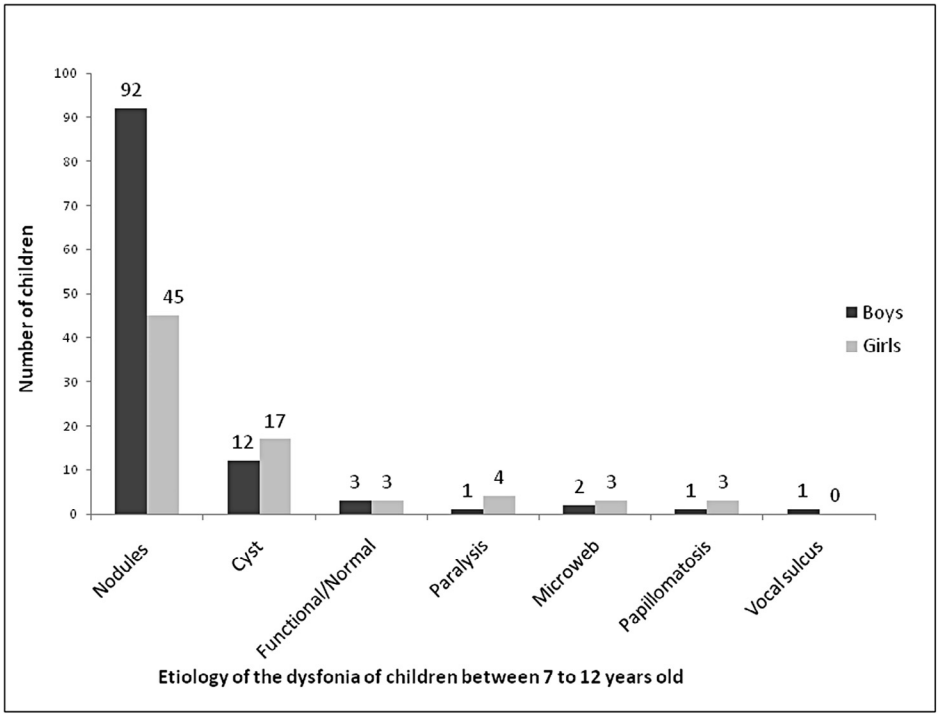

FIGURE 2. Laryngeal diagnosis of children aged between 7 and 12 years.

of 1 and 12 years, boys predominated, corroborating the findings of other authors.[1,4,9,15–18] The predominance of voice disorders among women has been reported by several authors, and the causes include the female glottic configuration, favoring glottic bowing, the vocal self-perception, the hormonal influence on vocal qualities, and the asymmetric concentration of hyaluronic acid in the lamina propria of the female larynx.[19]

Analyzing the many professions, we found a large percentage of patients doing domestic work or studying. However, in putting together all the activities that require a high vocal demand (teacher, salesperson, vendor, singer, preacher, telemarketing operator, etc.), we verified that domestic employees and students accounted for more than 30% of the patients, confirming the strong relation between dysphonia and professions with a high

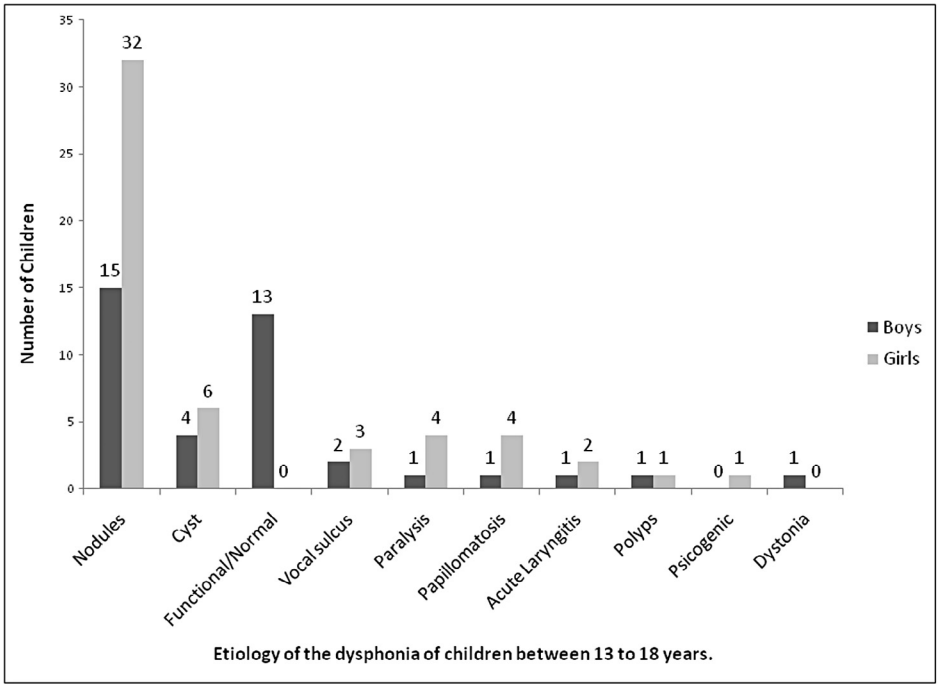

FIGURE 3. Laryngeal diagnosis of children aged between 13 and 18 years.

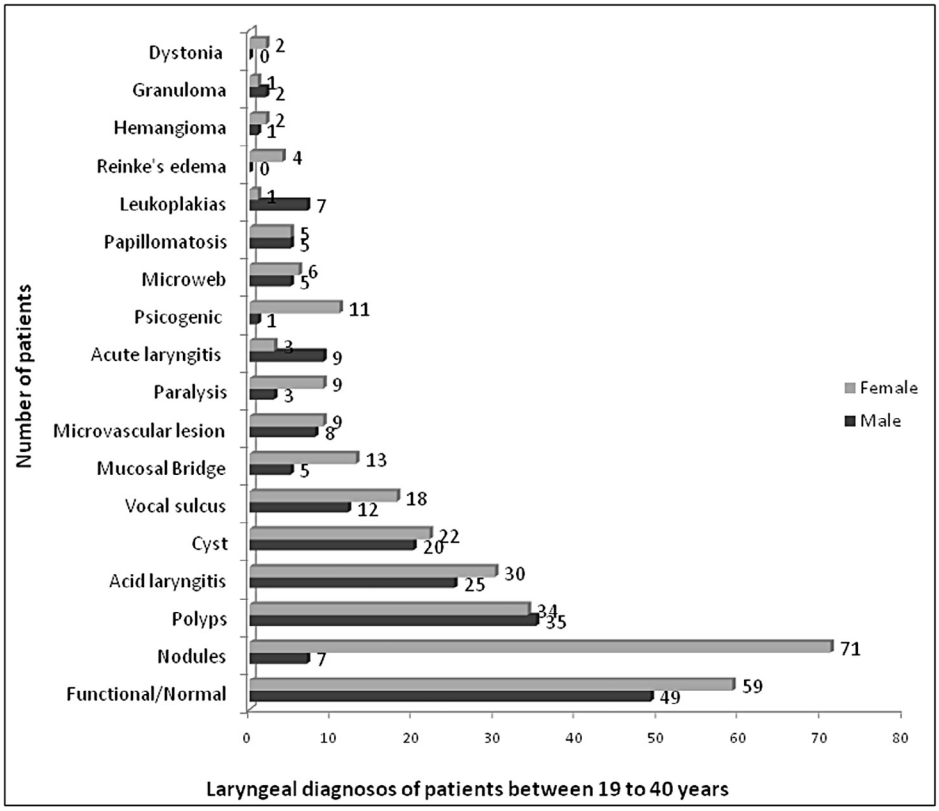

FIGURE 4. Laryngeal diagnosis of patients aged between 19 and 40 years.

vocal demand. It is worth highlighting that dysphonia was mentioned by 33% of the patients included in this study. Vocal damage produced by voice abuse may be clearly identified in teachers; 50–80% of this group of patients had dysphonia at some point of their careers.[18] Assunção et al.[20] evaluated the questionnaires answered by 649 teachers and found that 32% of them presented vocal symptoms, with a predominance of women. The authors underscored, among the main risk factors, long working hours, constant need for increasing voice intensity, excessive noise in the classes, smoking habits, air conditioning, and inhaled

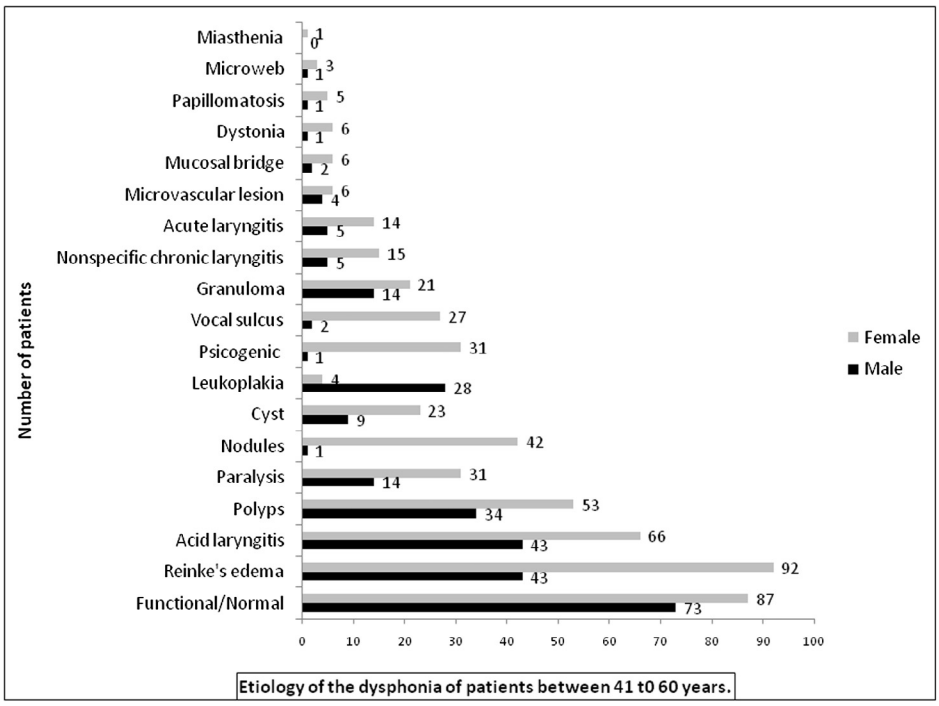

FIGURE 5. Laryngeal diagnosis of patients aged between 41 and 60 years.

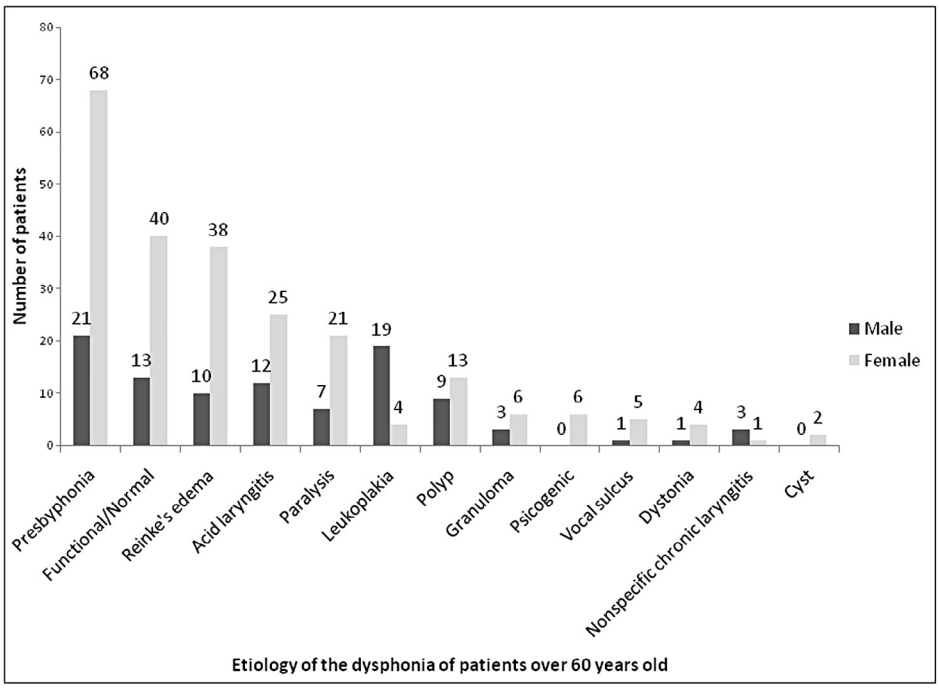

FIGURE 6. Laryngeal diagnosis of patients over 60 years old.

pollutants (dust and chalk powder), as also emphasized by other authors.[21–24] The studies comparing the incidence of voice disorders in teachers with that in other professions clearly demonstrate the high incidence of dysphonia in teaching professionals and its relationship to excessive phonatory demands. Akinbode et al.[23] evaluated 341 teachers and 155 professionals of other areas and found a prevalence of dysphonia in 42% of teachers against 18% in nonteachers. Similar results were reported by other authors such as Roy et al.[1] (57.7% versus 28.8%), Angellilo et al.[3] (51.4% versus 25.9%), and Van Houtte et al.[24] (51.2% versus 27.4%).

Among nonteachers, a prevalence of dysphonia between 3% and 9% is estimated.[4,15,21] Higher rates are reported in children, between 6% and 23%.[9,10,25,26] A smaller percentage was found by Bhattacharyya[15] in a populational study that identified 1.4% children with vocal disorders, the main diagnoses being laryngitis and allergies.

Functional dysphonia, vocal nodules, and laryngopharyngeal reflux were the most frequent diagnoses in the present study, adding, respectively, to 17%, 17%, and 10%. Functional voice disorders are the most frequent causes of dysphonia in many epidemiological studies. Those are vocal disorders occurring in the absence of laryngeal organic lesions that explain the symptoms, as in conversion aphonia, psychogenic dysphonia, and hyper- and hypodysfunctional dysphonia.[27]

In this study, among the laryngeal lesions, vocal nodules predominated in children. They affected 41% of the children younger than 6 years, with the incidence peaking to 73% between the ages of 7 and 12 years and decreasing to 51% between the ages of 13 and 18 years. Such values are close to those presented by Moreti et al.,[27] who diagnosed 62.6% vocal nodules in a population of 99 children between 7 and 15 years of age. Tavares et al.[26] identified functional dysphonia in 44% and vocal nodules in 31% of 259 children with dysphonia during laryngoscopies.

The higher incidence of vocal nodules in boys was evident in our study until the age of 12 years; from 12 years on, vocal nodules were more prevalent in girls and adult women, validating the findings of other authors.[7–10,26,28,29] Smillie et al.[29] evaluated 154 school-age children and diagnosed vocal nodules in 52%, which were most predominant in boys. Martins et al.[5] diagnosed 57% of vocal nodules and 15% of vocal cysts in 304 children between 4 and 18 years of age submitted to videolaryngoscopy, most of them boys (64%).

Vocal overuse and high-intensity voicing with effort, which are common in children and teachers, contribute to the pathophysiology of vocal nodules. In such conditions, the adduction of the vocal folds has a intense impact, causing trauma. Consequently, edema, microvascular injuries, and mucosal thickness appear. The point of strongest collision of the vocal folds is in the medium third; the local mucosa will suffer histological changes such as edema, and thickening of the epithelium and the basal membrane, resulting in nodule formation.[6,30] After adolescence, with laryngeal growth, especially in males, because of the action of sex hormones, vocal nodules tend to regress and reabsorb slowly and naturally.[6,30] This favorable outcome happens mainly in boys, in which laryngeal changes are more evident. For this reason, nodules surgery in children is not the treatment of choice, but rather vocal therapy.[31] The satisfactory results of vocal therapy in 29 children (14 boys and 15 girls) ranging in age from 5 to 12 years with the diagnosis of hyperfunctional dysphonia or vocal nodules, presented by Mackiewicz-Nartowicz et al.,[32] confirms the benefits of such treatment, as well as other authors' findings.[33,34]

Acid laryngitis was the third most frequent laryngeal diagnosis in this study (10%). Gastroesophageal symptoms are often

associated with vocal symptoms, especially laryngopharyngeal reflux, heightening the interest of researchers in the topic. For some authors, the gastric juice acts as a potent chemical irritant for the laryngeal mucosa, resulting in inflammation, mucosal thickening, pachydermia, polyps, and even leukoplakia.[35–39] Other researchers believe that the importance attributed to reflux has been overestimated because laryngeal lesions are caused by many factors and deserve more rigorous investigation.[40] In this study, for the videolaryngoscopy diagnosis of acid laryngitis, the symptoms of gastroesophageal reflux were considered, as well as the classic endoscopic findings, such as edema, pachydermia, mucosal thickening, and granulomas in the posterior glottic commissure. Acid laryngitis was diagnosed in 10% of the patients, and confirmed by pHmetry, although a larger number of patients reported gastroesophageal reflux (26.5%).

Nasosinusal symptoms are also frequent in patients with dysphonia and were reported by 24% of the patients in our study. Nasal secretions and constant cough result in inflammation and mucosal thickening, favoring dysphonia.[15,16,41]

Other laryngeal diagnoses often present were Reinke's edema (9.2%), polyps (8.9%), and vocal cysts (6%). Reinke's edema appears almost exclusively in chronic smokers older than 40 years, as already found by other authors and in this study.[42–45] It occurs mostly in women, causing the voice to become hoarse and virilized. In this study, Reinke's edema was the third most common cause of dysphonia in patients older than 60 years. Leukoplakia is also frequent in smokers, but in this study, this diagnosis might have been underestimated because oncologic patients, in whom leukoplakia is more often diagnosed, were excluded. Assunção et al.[20] evaluated 197 patients with dysphonia and found organic causes in 85% of the cases, mainly vocal nodules (24.4%), Reinke's edema (23.4%), vocal polyps (13.7%), contact ulcer (8.6%), unspecific chronic laryngitis (6.1%), vocal fold paralysis (5.6%), vocal cyst (2.5%), vocal sulcus (1%), and trauma (2%).

Polyps and vocal cysts are lesions related to vocal overuse, frequently found in children and voice professionals. Polyps are seen usually in adult patients. The origin of vocal polyps involves a number of factors, including allergies, vocal overuse, gastroesophageal reflux, inhaled pollutants, and smoking.[42,43] Cysts may be congenital, from the implantation of epidermal embryonic tissue, or mucous, which originates from the obstruction of the draining duct of a mucosal gland.[43,46,47] Vocal cysts are present in almost every age group; in this study, they were more frequent between 7 and 12 years of age.

Vocal cords paralysis was diagnosed in this study in 5.4% of the cases, in adults as well as in children. Unilateral paralysis is more frequent, mostly due to iatrogenic injury to the recurrent laryngeal nerve during intrathoracic surgical procedures, in children as well as in adults.[48–50] Jabbour et al.[50] analyzed retrospectively the causes of vocal cord paralysis in 404 children and found that unilateral paralysis was most frequent, especially on the left (66.8%), followed by bilateral paralysis (25.3%). The most common causes were iatrogenic injury from heart surgery (68.8%), idiopathic causes (21%), and neurological causes (7.4%). López Sousa et al.[51] presented a series of 12 neonates who were operated for ductus arteriosus, and observed that three of the cases progressed to vocal folds paralysis and dysphonia. Other causes of unilateral vocal fold paralysis include nerve compression by tumors or vessels in its cervical or intrathoracic portion.

In bilateral paralysis, the compression of the vagal nerve by expanding processes of the central nervous system predominates.[48–53] In this study, no child with bilateral paralysis was included because in such cases—due to the median or paramedian position of both vocal folds—respiratory symptoms predominate, justifying the exclusion of children with bilateral paralysis.

This study had a high number of patients with the diagnoses of vocal folds paralysis and older than 40 years because it is routine in our service to perform pre and post-operative laryngoscopy and vocal analysis in all patients submitted for thyroid or parathyroid surgery. This practice differentiates paralysis caused by tumor compression from iatrogenic paralysis. It also allows us to follow the recovery of the vocal cords mobility. In a study that included 400 patients with vocal cord paralysis, Reiter et al.[53] found iatrogenic causes in two thirds of the cases, thyroidectomy being the main cause for bilateral paresis in adults.

This study included a relatively large population of patients older than 60 years (16.5%), which justifies the 89 diagnoses of presbyphonia. We have reported a growing number of elderly patients who seek ambulatories because of vocal problems, and a greater interest in this patient population in vocal therapy. Yamauchi et al.[54] reported a 7% increase per year in the number of elderly patients with vocal disorders in the ambulatories for voice disorders. The above-mentioned authors analyzed 1157 patients with vocal disorder and observed that 37% were older than 65 years, of which 11% had vocal folds atrophy. Some studies have published the effectiveness of the interventions for presbyphonia such as voice therapy, neuromuscular electrical stimulation, and surgery. Such interventions may mitigate the symptoms related to aging voice.[55]

Minimal lesions of the vocal folds such as sulcus, mucosal bridges, microwebs, and microvascular lesions added to 7% of the laryngeal diagnosis of this present study. Vocal sulcus was the most prevalent lesion, being diagnosed early in a 3-year-old child. Such lesions may drastically compromise the voice, especially the sulcus vergeture because it is adherent to the vocal ligament, therefore compromising the muco-ondulatory movement.[56]

Less frequent laryngeal diagnoses were acute laryngitis (2.9%), psychogenic dysphonia (2.5%), vocal folds granulomas (2.3%), and laryngeal papillomatosis (1.4%). Acute laryngitis is often diagnosed in children, and the main etiology is viral. In viral infections of the upper airways, the inflammatory process extends to the mucosa of the vocal folds that present edema and hyperemia, hence hoarseness.[52]

Psychogenic dysphonia, although less frequent, was also an important diagnosis in this study because it was diagnosed early in one of the adolescents. When diagnosed in children or adolescents, psychogenic dysphonia usually reflects severe emotional problems connected to sexual abuse or death of a family member. According to Misono et al.,[57] symptoms of depression and anxiety may be present in one third of dysphonic patients, especially

women. Therefore, psychogenic dysphonia deserves psychological attention and treatment.

Laryngeal granulomas were diagnosed only in adult patients in this study, probably because we excluded children with glottic stenosis and stridor, which often present associated granulomas. Granulomas may be secondary to laryngopharyngeal reflux, phonotrauma, granulomatous laryngitis, or traumatic intubation.[58,59]

Finally, we mention laryngeal papillomatosis, which accounted for 1.48% of the laryngeal diagnoses in this study. Laryngeal papillomatosis is the most important benign laryngeal neoplasm, and the earlier it appears, the more it recidivates. Laryngeal lesions in adults are fewer and more localized. The subtypes of papillomavirus 6 and 11 are the most frequent and are rarely associated with neoplasm, different from subtypes 16 and 18, which coexist with laryngeal cancer in many cases.[11]

CONCLUSIONS

In this study, which included 2019 dysphonic patients, there was a predominance of adults and women. There were different etiologies of dysphonia in the age groups studied, with nodules and cysts predominating in children, functional dysphonia and reflux in adults, and presbyphonia in the elderly.

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