Multidimensional assessment of voice quality in patients with laryngopharyngeal reflux disease

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ABSTRACT:

Introduction: In phoniatric practice, we often observe voice quality disorders coexisting with gastroesophageal reflux disease. There can be damage to the mucosa as a result of stomach content being regurgitated into the laryngopharynx and larynx, which leads to pathological morphological changes in the larynx.

Aim: The aim of the study was to assess voice quality disorders, morphological changes in the larynx and etiological factors in patients with laryngopharyngeal reflux.

Material and method: The study included 726 patients with voice disorders and previously diagnosed gastroesophageal reflux disease. The severity of dysphonia was assessed with perceptual and acoustic methods as well as the Reflux Symptoms Index (RSI). Morphological control was conducted using high-speed digital imaging (HSDI) and the Reflux Finding Score (RFS). The barofunction of the upper esophageal sphincter was measured and 24-hour pH monitoring of exhaled air was performed.

Results: Dysphonia was reported by 422 women (82%) with laryngopharyngeal reflux (G2R2B0A0S2), confirmed by the RSI (average: 24.38 pts) and acoustic analysis of jitter (average: 1.5%) and shimmer (average: 4.2%). In the narrowband spectrogram, nonharmonic components were registered, especially in the upper band (type III, according to Yanagihara). Voice disorders were the most frequently a result of hypertrophy (97.67%) and congestion of the intra-arytenoid mucosa (96.70%) in women and thickening (97.16%) and edema (80.57%) of the larynx mucosa in men. RFS results (average: 12.37 pts) confirmed the reflux background of morphological changes. Reduction of upper esophageal sphincter pressure and acidic air exhalation predisposed the patients to morphological changes within the larynx.

Conclusions: Perceptual (GRBAS) and acoustic analysis indicated the existence of voice disorders in laryngopharyngeal reflux. Assessment of the larynx with HSDI and RFS confirmed the existence of pathological changes classified as reflux laryngitis. The barofunction of the upper esophageal sphincter, pH monitoring and RSI indicated the existence of laryngeal consequences of reflux disease.

KEYWORDS: 24-hour pHmetry, pH monitoring, dysphonia, HSDI, laryngopharyngeal reflux (LPR), morphological changes in LPR

INTRODUCTION

Gastroesopharyngeal reflux disease (GERD) is a common disease in the global population [1–6]. At the Congress of Gastrology in Montreal in 2006, the definitions of GERD and laryngopharyngeal reflux disease (LPRD) were established [3]. As a result of regurgitating acidic stomach content to the larynx and laryngopharynx, secondary damage of the upper respiratory tract mucosa is observed; this tissue is more sensitive to hydrochloric acid and pepsin than the esophageal mucosa [7].

The symptomatology of LPR has been differentiated and includes many unspecific symptoms, a fact which impedes differential diagnosis [8]. When suspecting LPR, pH measurement of gas and...
According to Koufman et al. [14], in the course of LPR, many disorders may be observed in vocal fold mobility, such as paradoxical movement of the vocal folds or contraction of the glottis. According to Lechien et al. [18], intense cough, the need to clear the throat from accumulated thick secretion or hard type of phonation in the course of reflux disease may lead to general inflammation of the laryngeal mucosa and as a consequence of hoarseness.

According to Koufman et al. [14], in 70% of patients, organic changes in the course of LPR result from hyperfunction of the larynx. Cough or grunting in LPR also cause the hyperfunctional mechanism of phonation to occur. Cough reflex is connected with strong contractile activity, especially within the glottis [19].

The complex nature of LPR indicates the need for an interdisciplinary approach and the cooperation of various specialists during the diagnostic and therapeutic process of patients with LPR.

**AIM**

The aim of the study was to assess voice quality, morphological changes and etiological factors in patients with laryngopharyngeal reflux.

**MATERIAL AND METHOD**

The patient group (Group I) consisted of 726 patients with voice disorders treated at the Phoniatric Outpatient Clinic of the University Hospital in Białystok and diagnosed at the Department of Clinical Phonaudiology and Speech Therapy of the Medical University of Białystok between 2016 and 2023. The group was comprised of 515 women (71%) and 211 men (29%), aged 25 to 69 years (average: 51). The patients had been diagnosed with GERD, either with pH monitoring (276 [38%]) or gastroscopy (450 [62%]). In all patients, regurgitation and/or heartburn at least 3 times a week was observed, which is in compliance with the diagnostic guidelines established at the Gastrological Congress in Montreal in 2006 (Montreal Consensus) [20]. At the time of the study, the patients were not being treated for reflux disease or had discontinued medications for more than 3 months due to their ineffectiveness. The subjects did not use their voice professionally, were non-smokers, did not consume alcohol and had no diseases of the upper respiratory tract, hormonal disorders or diseases with a psychogenic origin. Patients with symptoms of reflux according to the RSI were included in the study. In the assessment of each symptom that persisted for at least 1 month, a 5-point scale was used. Patients who scored more than 13 points were qualified for the study.

The control group (Group II) consisted of 70 subjects without voice disorders. The group included 49 women (70%) and 21 men (30%), aged 23 to 52 (average: 43). These were subjects without a diagnosis of GERD or LPR, non-smokers who did not consume alcohol and had no upper respiratory tract diseases or professional voice burden.

All patients gave their written consent for participation in the study.

In the perceptual assessment of voice quality conducted by specialists, the standardized GRBAS scale developed by the Japanese Society...
Maximum phonation time (MPT) was determined; the results are given in seconds, representing the average value of 3 repetitions. An assessment was conducted of hoarseness type according to Yanagihara’s classification (types I–IV) in a spectrographic examination for the presence of harmonics and non-harmonics in the frequencies of “a” vowel formant [21]. An acoustic analysis of the voice was conducted in a soundproof room using a SHURE SM86 microphone with a cardioid characteristic and an extended upper band placed 10 cm from the patient’s mouth.

The assessment of upper esophageal sphincter barofunction was performed using a laryngological pressure meter (LPM) by WM Laboratory, where resting and dynamic tension were recorded during swallowing. An LPM consists of a tension applicator, measurement tube and electronic devices with dedicated software. The LPM supplies air through its tube to the esophagus within 25 seconds. The polyethylene tube is introduced through the nose and nasopharynx with simultaneous graphical registration of the pressure in the upper esophageal sphincter. Changes in pressure (mmHg) are registered graphically in the upper esophageal sphincter within 25 seconds.

24-hour pH monitoring was performed using a minimally invasive system for diagnosing laryngopharyngeal reflux (Restech Dx-pH). The system records pH values and identifies correlations between the symptoms of LPR caused by extreme acidity or alkalinity or of Speech Therapists and Phoniatricians was used, wherein G represents the grade of hoarseness, R means the roughness of voice, B is for breathiness, A for asthenicity and S means voice strain – assessed on a 0–3 scale.

In the visualization of the larynx, a high-speed digital imaging (HSDI) technique by R. Wolf and a high-speed (HS) camera with 90° rigid optics was used, allowing for the assessment of real vibrations of the vocal folds. The regularity, symmetry and amplitude of vibrations of the vocal folds, mucosal wave (MW) morphology, glottal closure and the value of the open quotient (OQ) in the anterior, middle and posterior segments were analyzed. The use of an HS camera in HR mode provided a morphological image of the laryngeal mucosa. In the assessment of morphological changes of the larynx, the Reflux Finding Score (RFS) was used, grading their severity from 0 to 4.

Acoustic examination of the subjects’ voice was performed with the software program DiagnoScope Specjalista by DiagNova Technologies. Twofold phonation of the vowel “a” was recorded, as was continuous, phonematically balanced linguistic text, starting with the words “Dziś jest ładna pogoda...” (“Today the weather is nice...”). The value of Fundamental Frequency (F0) was assessed, as was jitter, shimmer and noise-to-harmonics ratio (NHR). The narrowband spectrogram was analyzed and the average value of the maximum phonation time (MPT) was determined; the results are given in seconds, representing the average value of 3 repetitions. An assessment was conducted of hoarseness type according to Yanagihara’s classification (types I–IV) in a spectrographic examination for the presence of harmonics and non-harmonics in the frequencies of “a” vowel formant [21]. An acoustic analysis of the voice was conducted in a soundproof room using a SHURE SM86 microphone with a cardioid characteristic and an extended upper band placed 10 cm from the patient’s mouth.

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**Tab. I. Evaluation of vocal fold vibration parameters using an HSDI technique by R. Wolf.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>Number</th>
<th>Amplitude</th>
<th>Mucosal Wave</th>
<th>Regularity</th>
<th>Symmetry</th>
<th>Synchrony</th>
<th>Clottal Insufficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Women</td>
<td>n = 422 (82%)</td>
<td>Reduced</td>
<td>Reduced</td>
<td>Present</td>
<td>Present</td>
<td>Lack</td>
<td>Present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 93 (18%)</td>
<td>Reduced</td>
<td>Reduced</td>
<td>Lack</td>
<td>Lack</td>
<td>Lack</td>
<td>Present</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 167 (79%)</td>
<td>Reduced</td>
<td>Reduced</td>
<td>Lack</td>
<td>Lack</td>
<td>Lack</td>
<td>Lack</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>n = 44 (21%)</td>
<td>Reduced</td>
<td>Physiological</td>
<td>Present</td>
<td>Lack</td>
<td>Present</td>
<td>Lack</td>
</tr>
<tr>
<td>II</td>
<td>Women</td>
<td>n = 44 (89%)</td>
<td>Physiological</td>
<td>Physiological</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Lack</td>
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<tr>
<td></td>
<td></td>
<td>n = 5 (11%)</td>
<td>Physiological</td>
<td>Reduced</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Lack</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n = 17 (80%)</td>
<td>Physiological</td>
<td>Physiological</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Lack</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>n = 4 (20%)</td>
<td>Reduced</td>
<td>Reduced</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>

**Tab. II. Assessment of upper esophageal sphincter pressure in mmHg (LPM, f. WM Laboratory) resting and swallowing in women and men in Groups I and II.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Gender</th>
<th>Number</th>
<th>Parameter</th>
<th>Number</th>
<th>Number</th>
<th>Parameter</th>
<th>Number</th>
<th>Number</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>resting</td>
<td>515</td>
<td>211</td>
<td>resting</td>
<td>49</td>
<td>21</td>
<td>resting</td>
<td>515</td>
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<td>49</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>swallowing</td>
<td>7.084</td>
<td>14</td>
<td>swallowing</td>
<td>392</td>
<td>14</td>
<td>swallowing</td>
<td>7.084</td>
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<td>392</td>
<td>14</td>
<td>swallowing</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum value [mmHg]</td>
<td>2</td>
<td>12</td>
<td>1</td>
<td>12</td>
<td>1</td>
<td>12</td>
<td>2</td>
<td>12</td>
<td>1</td>
<td>12</td>
<td>2</td>
<td>12</td>
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<td></td>
<td></td>
<td></td>
<td>Maximum value [mmHg]</td>
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<td>81</td>
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<td>81</td>
<td>32</td>
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<td>32</td>
<td>100</td>
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<td>100</td>
<td>32</td>
<td>100</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Median [mmHg]</td>
<td>10</td>
<td>7.38</td>
<td>10</td>
<td>7.38</td>
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<td>32</td>
<td>100</td>
<td>32</td>
<td>100</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Mean [mmHg]</td>
<td>13.04</td>
<td>38.83</td>
<td>13.04</td>
<td>38.83</td>
<td>24.67</td>
<td>73.44</td>
<td>24.67</td>
<td>73.44</td>
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<td>24.67</td>
<td>73.44</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>p-value</td>
<td>Women Group I vs Group II</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
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<td>Men Group I vs Group II</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
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<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
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drops in pH. The device is equipped with a probe with a pH sensor; it is inserted through the nasal cavity into the oropharynx 1 cm below the uvula. The results are presented in graph form and are used to calculate the Ryan score. According to the producer, the normative Ryan score is 0 for the supine and upright positions. Values above 6.8 for a supine position and 9.41 for an upright position indicate the existence of LPR [22].

The study was granted the consent of the Bioethical Committee of Medical University of Bialystok (no. R-I-002/77/2019).

In the statistical analysis of acoustic parameters (F0, jitter, shimmer and NHR), OQ values and upper esophageal sphincter barofunction, one-way analysis of variance (ANOVA) was used, with the level of statistical significance set at p ≤ 0.05.
RESULTS

According to the GRBAS scale, moderate hoarseness (G2), roughness (R2) and strain (S2) were registered in 422 (82%) of the women in Group I (G2R2B0A0S2). In 93 (1%) of the women, hoarseness was significant (G3), roughness was moderate (R2) and strain was significant (S3) (G3R2B0A0S3). Among the men, in 167 (79%) we observed moderate hoarseness (G2), roughness (R2) and strain (S2) (G2R2B0A0S2). In 44 men (21%), hoarseness was mild (G1), roughness was moderate (R2) and strain was mild (S1) (G1R2B0A0S1).

In 44 women (89%) in the control group (Group II), hoarseness (G0), roughness (R0), breathiness (B0), asthenicity (A0) and strain (S0) were not observed (G0R0B0A0S0). In 5 (11%) of the women, mild hoarseness (G1) was observed (G1R0B0A0S0). In 17 men (80%) in the control group, no symptoms of dysphonia were observed (G0R0B0A0S0). Mild hoarseness (G1) and mild roughness (R1) were observed in 4 men (20%) (G1R1B0A0S0).

In Group I, the average RSI score was 24.38 (25.23 for the women and 22.25 for the men). In Group II, the average RSI score was 8.34 among women and 6.72 for men. The RSI analysis is presented in Fig. 1.

Thickening of the mucosa was observed in 503 women (97.67%), mucosal congestion in 498 (96.7%) and edema of the larynx mucosa in 442 (85.83%). Among the men, thickening of the larynx mucosa was observed in 205 (97.16%), diffused laryngeal edema in 170 (80.5%) and mucosal congestion in 163 (77.25%) (Fig. 2.). Laryngeal granulomas were observed in 54 women (10.49%) and 35 men (16.59%).

In Group I, the average RFS score was 12.37 (12.58 for the women and 11.86 for the men). In Group II, it was 4.06 (4.12 for women and 3.92 for men) (Fig. 3.).

In 422 women (82%) from Group I, reduced vibration amplitude and limitation of mucosal wave were observed. In 93 (18%), irregularity, asymmetry and asynchrony of vibrations were also found. Glottal insufficiency was observed in all women. The aforementioned parameters indicate changes in the larynx that are hypertrophic and edematous in nature with glottal insufficiency. In 167 men (79%), vibration amplitude was reduced, mucosal wave was limited and vibrations were irregular, asymmetric and asynchronic. These parameters confirm the existence of hypertrophic changes with physiological glottal closure.

Among both women and men in Group II, the parameters of vocal fold vibration analysis were physiological, apart from 4 (20%) of the men in whom a reduction of vibration amplitude, mucosal wave limitation and glottal insufficiency were observed (Tab. I).

In 515 (100%) women from Group I, the average value of OQ in the posterior segment of the glottis was 0.94; in the middle segment, the average was 0.48 and in the anterior segment 0.23. In men, the average value of OQ in the posterior segment was 0.84; in the middle segment it was 0.43 and in the anterior segment 0.27. For both genders in Groups I and II, the values of OQ in the posterior, middle and anterior segments were statistically significantly different (Fig. 4.).

In 422 women (82%) from Group I, the average value of F0 was 230 Hz; in the remaining 93 (18%) it was 242 Hz. In 167 men (79%), the average F0 was 135 Hz; in the remaining 44 (21%) it was 129 Hz.

In Group II, the average value of F0 was 249 Hz among women and 141 Hz among men (Fig. 5.).

In the women in Group I, the average value of jitter was 1.5%, the average shimmer value was 4.2% and the average NHR was 3.9. In the men, jitter was on average 1.7%, shimmer 5.8% and NHR 4.7.

In the women in Group II, the average value of jitter was 0.3%, the average shimmer value was 3.4% and the average NHR was 3.8. In the men, the average value of jitter was 0.5%, shimmer 4.1% and NHR 4.6 (Fig. 6.–7.).

In Group I, the narrowband spectrograms showed the presence of nonharmonic components in the upper band: type III hoarseness in 502 (69.1%), type II in 115 (15.8%), type IV in 86 (11.8%) and type I in 3 (3.2%), according to Yanagihara’s classification.

In 42 subjects (60%) in Group II, type II hoarseness was registered; in the remaining 28 (40%), type I was found (Fig. 8.).

In Group I, the average value of MPT was 13.03 sec (14.07 sec for the women and 11.20 sec for the men).

In Group II, the average value of MPT was 21.45 sec (23.74 sec for the women and 19.80 sec for the men).

In Group I, the average value of resting pressure within the upper esophageal sphincter was 12.49 mmHg (13.04 mmHg among women and 11.16 mmHg among men). During swallowing, the average value was 38.72 mmHg (38.83 mmHg in women and 38.45 mmHg in men).
DISCUSSION

Gastroesophageal reflux disease (GERD) is a common issue in the global population. Symptoms of reflux are often accompanied by voice disorders in the form of hoarseness, the accumulation of thick, sticky secretion, grunting, cough, etc. It is a result of irritation of the laryngeal mucosa, which is sensitive to acid and exhaled gases. Significant voice disorders were observed in the patient group, especially in women, determined as G3R2B0A0S3. Similar results in perceptual voice assessment with the GRBAS scale were reported for patients with LPR by Lechien et al. [18].
22.31 and in a supine position 11.45. However, the wide range of pH values classified as pathologic should be taken into consideration. According to Byrne et al. [23], 24-hour pH monitoring in patients with LPR symptoms indicated a pathologic result of esophageal acidity in as many as 91.3% of patients. Many researchers reported a reduction in values of upper esophageal pressure as a cause of LPR [24–31]. A study by Passeretti et al. [32] revealed lower values of upper esophageal sphincter tension in patients with LPR symptoms, confirmed by pH monitoring and Ryan score. Also, Babei et al. [31] observed lower values of upper esophageal sphincter tension in patients with LPR in comparison to those in healthy subjects. A study by Byrne et al. [23] revealed that patients diagnosed with reflux laryngitis suffer from reduced upper esophageal sphincter pressure, but also from reduced lower esophageal sphincter pressure. In the current study, among the patients, significantly lower values of upper esophageal sphincter tension at rest and during swallowing were observed, both in women and men. Monitoring of the pH of exhaled air confirmed the existence of reflux laryngitis.

especially in the grade of hoarseness (G), voice roughness (R) and voice strain (S). Irritation of the larynx results in morphological changes in its mucosa, most frequently in the form of mucosa thickening (97.67%) and congestion (96.70%), as well as larynx edema (85.83%). In men, thickening (97.16%) and edema (80.57%) of the vocal folds are observed. In compliance with the guidelines of the Gastrological Congress in Montreal, those changes are defined as laryngopharyngeal reflux. The current criteria for recognizing reflux laryngitis are an RSI score of ≥13 pts and an RFS of ≥7 pts [11, 13]. In the patient group, the average RSI score was 24.38 (25.23 in women and 22.25 in men), which additionally confirmed the accuracy of diagnosis. The existence of LPR in the patient group was confirmed by the statistically significant differences in upper esophageal sphincter pressure in both genders: an average of 12.49 mmHg (13.04 mmHg in women and 11.16 mmHg in men) at rest and 38.72 mmHg (38.83 mmHg in women and 38.45 in men) during swallowing. In the patient group, pathological values of pH were observed in 92% of subjects, where the average Ryan score in an upright position was 22.31 and in a supine position 11.45. However, the wide range of pH values classified as pathologic should be taken into consideration. According to Byrne et al. [23], 24-hour pH monitoring in patients with LPR symptoms indicated a pathologic result of esophageal acidity in as many as 91.3% of patients. Many researchers reported a reduction in values of upper esophageal pressure as a cause of LPR [24–31]. A study by Passeretti et al. [32] revealed lower values of upper esophageal sphincter tension in patients with LPR symptoms, confirmed by pH monitoring and Ryan score. Also, Babei et al. [31] observed lower values of upper esophageal sphincter tension in patients with LPR in comparison to those in healthy subjects. A study by Byrne et al. [23] revealed that patients diagnosed with reflux laryngitis suffer from reduced upper esophageal sphincter pressure, but also from reduced lower esophageal sphincter pressure. In the current study, among the patients, significantly lower values of upper esophageal sphincter tension at rest and during swallowing were observed, both in women and men. Monitoring of the pH of exhaled air confirmed the existence of reflux laryngitis.
Voice assessment. Statistically significant differences in the values of jitter and shimmer (p<0.001) were observed. Statistically significant differences were not observed regarding NHR in either group, in either women or men (p<0.067, p<0.053). On the narrowband spectrograms, numerous nonharmonic components were observed in the upper band in patients 502 (69.1%) Group I, which was classified as severe hoarseness, type III, according to Yanagihara.

The symptomatology of LPR varies, which impedes differential diagnostics. An unambiguous and objective recognition of the clinical form of dysphonia in patients with reflux laryngitis ensures

According to Babei et al. [23], monitoring of pH values and upper esophageal sphincter values should be applied in the diagnostics of reflux laryngitis.

Due to various symptomatology, the differential diagnosis of dysphonia in patients with LPR is very difficult. A properly gathered and directed case history is important. The commonly used 26-point RFS, which assesses the morphological image of the larynx, does not confirm and totally exclude the existence of laryngeal manifestations of reflux disease [33]. The assessment of the real vibrations of vocal folds using an HSDI technique with a camera in HS and HR mode allowed for objective diagnostics of vocal fold vibration (HS mode) and the severity of morphological changes (HR mode). Limitation of mucosal wave (MW), asymmetry, asynchrony and irregularity of vibrations and reduction of amplitude indicated the existence of hypertrophic, edematous and vascular changes in the laryngeal mucosa, which were especially strong in the women. The thorough morphological analysis of the larynx, possibly due to the application of a high-speed camera in HR mode, determined the existence and severity of pathological changes in the larynx, previously diagnosed based on the value of RFS, indicating its diagnostic value. The assessment of OQ objectively confirmed the occurrence of glottal insufficiency in the posterior segment, especially in women diagnosed with LPR (average value: 0.94), while the value of OQ in the women from the control group was 0.64. It is possible that the high value of OQ in the posterior segment resulted from the coexistence of edematous changes in the laryngeal mucosa, which was observed especially in women and was classified as a clinical form of reflux laryngitis.

Voice disorders, which were especially strong in women in the perceptual assessment (G2R2B0A0S2, and in 18% even G3R2B0A0S3), were in compliance with the results of the parametric and spectrographic voice assessment. The symptomatology of LPR varies, which impedes differential diagnostics. An unambiguous and objective recognition of the clinical form of dysphonia in patients with reflux laryngitis ensures
successful therapy and improves prognosis. It is important to educate physicians and patients about the possibility of reflux disease impacting voice quality, because knowledge on the subject seems to be insufficient.

CONCLUSIONS

1. Perceptual analysis of voice on the GRBAS scale and the results of acoustic analysis indicated the existence of voice quality disorders in LPR.

2. Evaluation of the larynx using an HSDI technique and according to the scale of morphological changes in the larynx (RFS) confirmed the existence of pathological changes classified as reflux laryngitis.

3. Barofunction of the upper esophageal sphincter, the pH of air exhaled and the results of RSI indicated the existence of laryngeal consequences of reflux disease.

REFERENCES


