Original Article / Çalışma - Araştırma

Effect of laryngopharyngeal reflux on the improvement of chronic rhinosinusitis without polyposis after primary endoscopic sinus surgery

Primer endoskopik sinüs cerrahisi sonrası polipozis olmayan kronik rinosinüzitin iyileşmesinde larengofarengeal reflünün etkisi

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ABSTRACT

Objectives: This study aims to investigate the influence of laryngopharyngeal reflux on the improvement of chronic rhinosinusitis (CRS) in patients who underwent endoscopic sinus surgery (ESS).

Patients and Methods: A total of 48 patients (28 males, 20 females; mean age 41.6±15.1 years; range 18 to 75 years) with CRS without polyposis were assessed for the presence of gastric reflux with Reflux Symptom Index (RSI) and Reflux Finding Scores (RFS) before undergoing primary ESS. Patients with a RSI >12 and RFS >7 were included in the reflux(+) and those with either score under these cutoffs in the reflux(–) group. Improvement scores were accepted as the difference between preoperative scores and postoperative sixth-month Lund-Mackay Radiology Scores, Lund-Kennedy Endoscopy Scores (LKES), and Sinusitis Symptom Scores (SSS).

Results: There was no significant difference between improvements of the reflux(+) and reflux(–) groups in terms of radiology, endoscopy, and symptom scores ($p>0.05$). However, preoperative and postoperative six-month radiology scores were significantly higher in reflux(+) patients ($p<0.01$). Also, postoperative six-month LKES were significantly higher in reflux(+) patients. No statistically significant differences were detected between preoperative and postoperative six-month SSS in reflux(+) or reflux(–) patients.

Conclusion: Laryngopharyngeal reflux was associated with worse radiology and endoscopy scores in CRS without polyposis; however, it had no role on the improvement scores after primary ESS.

Keywords: Chronic rhinosinusitis; endoscopic sinus surgery; flexible laryngoscopy; laryngopharyngeal reflux.

ÖZ

Amaç: Bu çalışmada endoskopik sinüs cerrahisi (ESC) geçirmiş hastalarda larengofarengeal reflünün kronik rinosinüzitin (KRS) iyileşmesi üzerindeki etkisi araştırıldı.

Hastalar ve Yöntemler: Polipozis olmayan KRS'li toplam 48 hasta (28 erkek, 20 kadın; ort. yaş 41.6±15.1 yıl; dağılım 18-75 yıl) primer ESC geçirmeden önce Reflü Semptom İndeksi (RSİ) ve Reflü Bulgu Skorları (RBS) ile gastrik reflü varlığı bakımından değerlendirildi. Reflü Semptom İndeksi >12 ve >7 olan hastalar reflü(+), bu ayrımın altında skoru olanlar reflü(–) grubuna dahil edildi. İyileşme skorları ameliyat öncesi skorlar ve ameliyat sonrası altıncı ay Lund-Mackay Radyoloji Skorları, Lund-Kennedy Endoskopi Skorları (LKES) ve Sinüzit Semptom Skorları (SSS) arasındaki farklılık olarak kabul edildi.

Bulgular: Reflü(+) ve reflü(–) gruplarının iyileşmeleri arasında radyoloji, endoskopi ve semptom skoları açısından anlamlı farklılık yoktu ($p>0.05$). Ancak ameliyat öncesi ve ameliyat sonrası altıncı ay radyoloji skorları reflü(+) hastalarda anlamlı olarak daha yüksekti ($p<0.01$). Ayrıca, ameliyat sonrası altıncı ay LKES reflü(+) hastalarda anlamlı olarak daha yüksekti. Reflü(+) ve reflü(–) hastalarda ameliyat öncesi ve ameliyat sonrası altıncı ay SSS arasında istatistiksel olarak anlamlı farklılık saptanmadı.

Sonuç: Larengofarengeal reflü polipozis olmayan KRS'de daha kötü radyoloji ve endoskopi skorlarıyla ilişkiliydi; ancak primer ESC'den sonraki iyileşme skorları üzerinde etkiye sahip değildi.

Anahtar Sözcükler: Kronik rinosinüzit; endoskopik sinüs cerrahisi; flexibl larengoskopi; larengofarengeal reflü.

Available online at
www.kbbihtisas.org
doi: 10.5606/kbbihtisas.2016.78972
QR (Quick Response) Code

Received / *Geliş tarihi:* January 08, 2015 Accepted / *Kabul tarihi:* December 25, 2015

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Chronic rhinosinusitis (CRS) is a long standing inflammation that impacts significantly on patient quality of life and productivity. Endoscopic sinus surgery (ESS) is the final stage in the treatment protocol of the disease. However, surgery has some limitations and is not a typical cure for chronic sinus disease. Several studies have been conducted to elucidate the common causes of failure in ESS. The reasons for failure of surgery, predictive factors, preventive strategies and ways to proceed after failure, have been discussed by experts. Many different reasons including incomplete tissue removal, aggressive disease that does not respond to surgery and disorders of ciliary motility have been recognized for CRS recurrence after surgery. However, following a number of studies on the contributing role of gastric acid reflux on poor outcome after ESS, laryngopharyngeal reflux (LPR) has become a significant factor in disease persistence or recurrence after surgery.[1] Although many authors assert that the presence of acidic reflux in nasal cavities may promote the development of CRS, there are others who argue that there is no clear evidence to implicate the reflux of gastric contents into the nasal cavity in the etiology of CRS.[2] However, considering the evidence of an esophageal-nasal reflex, particularly in regard to mucus secretion and symptoms of postnasal drip, LPR would therefore be expected to worsen sinusitis symptom, radiology and endoscopy scores.

Within the context of these suggestions about the supplementary effect of LPR in worsening CRS, we aimed to investigate the effect of acidic reflux on the improvement of CRS without polyposis in patients who underwent primary ESS.

PATIENTS AND METHODS

Study design and patient selection

This prospective observational clinical study was designed to assess the effect of LPR on the improvement of CRS in the long-term in patients undergoing primary ESS between January 2013 and June 2014. The study was approved by the Institutional Review Board Istanbul Haydarpaşa Numune Education and Research Hospital with the study ID (HNEAH-KAEK 2013/96) and included patients over 18 years of age who were scheduled to undergo primary ESS for treatment of CRS without polyposis. Informed consent was obtained from all patients. The study was conducted in accordance with the principles of the Declaration of Helsinki.

The diagnosis of CRS was based on at least two of the following symptoms: anterior/posterior mucopurulent drainage, nasal obstruction, facial pain/pressure/fullness, and hyposmia lasting for 12 weeks or longer along with endoscopic or radiologic evidence of mucosal inflammation.[3] Patients were evaluated for the presence of gastric reflux with Reflux Symptom Index (RSI) and Reflux Finding Scores (RFS) and were divided into LPR+ and LPR– group before undergoing surgery.

Patients with immunocompromised status, with a history of previous ESS, mucociliary disorders, allergic fungal sinusitis or with allergy and those who have been treated previously for gastric reflux disease were excluded. In total, 49 patients entered the study. However, one further patient dropped out before the six-month endoscopic and radiologic evaluation and the study completed with 48 patients (28 males, 20 females; mean age 41.6±15.1 years; range 18 to 75 years).

Data collection

Subjective outcomes

Subjective data were collected from patient questionnaires comprising the RSI which is a nine-item (hoarseness, clearing the throat, excess throat mucus or postnasal drip, difficulty in swallowing, coughing after eating, breathing difficulties or choking episodes, troublesome cough, sensations of a lump in the throat, heartburn, or stomach acid coming up), self-administered questionnaire designed to assess various symptoms of LPR proposed by Belafsky et al.[4] Each item is scaled from 0 to 5, with a maximum score of 45. Patients were all requested by a surgeon (always the same) to complete the RSI questionnaire once before going to surgery and a score greater than 12 was accepted as being diagnostic for a possible LPR.[5]

The most widely used Sinusitis Symptom Questionnaire (SSQ) was the second subjective grading scheme of the study. Patients were asked by a second surgeon (always the same, blinded to the RSI scores), before surgery and six months after surgery to assess seven items including nasal blockage, headache, facial pain, alteration in the sense of smell, nasal discharge, sneezing

and overall symptoms on a scale of 0 to 10 with 0 indicating the absence of symptoms and 10 the presence of extremely severe symptoms.[6]

Objective outcomes

Objective data were collected from nasal endoscopy and flexible laryngoscopy performed following questionnaire scoring. The Reflux Finding Score (RFS), developed by Belafsky and Rees[5] was recorded for all of the patients by a third surgeon blinded to RSI and SSQ results after flexible laryngoscopy before undergoing surgery. Eight items [Pseudosulcus (infraglottic edema), ventricular obliteration, erythema/hyperemia, vocal fold edema, diffuse laryngeal edema, posterior commissure hypertrophy, granuloma/granulation, thick endolaryngeal mucus] were evaluated and scaled from 0 to 4. The worst possible score on the RFS is 26, and a score above 7 is determined to be abnormal. Patients with a RSI >12 and RFS >7 were accepted to have LPR.[7] Patients informed of their LPR diagnosis were referred to Gastroenterology Department and, with the consent of the gastroenterologists were scheduled for further treatment at postoperative six-month follow-up.

The Lund-Mackay radiologic grading system (LMRS) (0-12, for each side) and endoscopic appearances quantified with regard to the Lund-Kennedy endoscopic scoring system (LKES) for the presence of polyps (0= none, 1= confined to the middle meatus, 2= extending beyond the middle meatus), edema (0= absent, 1= mild, 2= severe) and discharge (0= none, 1= clear and thin, 2= thick and purulent) were preferred as the primary objective outcome measures in the long-term. A fourth surgeon, blinded to RSI and RFS, scaled patient's LKES and LMRS before and six-months after ESS. The LKES and LMRS of every patient was calculated by summing each of these scores for both sides and dividing each by two.

Surgical procedure and postoperative care

Endoscopic sinus surgery was performed by the same two surgeons under general anesthesia. The extent of ESS was defined based on the technique described by Messerklinger.[8] Surgery was scaled using endoscopic sinus surgery scoring system (0= no surgery done, 1= surgery done).[6] Surgery scores were calculated by summing the scores of both sides and dividing by two. Non absorbable packing materials used for hemostasis were removed on postoperative day two and patients were asked to attend the clinic for postoperative debridement on day seven, 15, at one month. Improvements were assessed at six-month follow-up.

Sample size

Given the parallel design of the study, power and sample size were calculated based on the six-month outcomes of CRS using a comparison of postoperative SSQ scores, LKES and LMRS between patients with and without LPR. Based on sensitivity analysis using data collected from LMRS, a sample size of at least 17 patients in each group was found to give significant differences in the means of LMRS between groups (δ= 2.2; SD: 2.1; with power assumed to be 80%, and significance level alpha (α) assumed to be 0.05).

Statistical analysis

Number Cruncher Statistical System (NCSS) 2007 and Power Analysis and Sample Size (PAS) 2008 statistical software (Utah, USA) were used for statistical analysis of the results. For quantitative analyses, the Student's t test was used when comparing groups with parameters that had a normal distribution and the Mann-Whitney U test was used when comparing groups with parameters that did not have a normal distribution. The paired sample t test was used to compare intragroup parameters that had a normal distribution. Qualitative analyses were performed using chi-square, Yates continuity correction and Fisher's exact chi-square tests. Pearson correlation analysis was used to determine the correlation between parameters. Results were evaluated at the 95% confidence interval with an accepted level of significance of $p<0.05$.

RESULTS

All patients were diagnosed as having CRS without nasal polyps (CRSsP). Seventeen patients (34.7%) with a RSI >12 and RFS >7 were accepted to have LPR; 32 patients (65.3%) were free of LPR. The distribution of LPR scores among patients is detailed in Table 1, while the distribution of preoperative and postoperative LMRS, LKES and SSQ of the participants is shown in Table 2.

No statistically significant differences were found between patients with and without LPR with regard to patients' mean age and gender (Table 3).

Table 1. Distribution of laryngopharyngeal reflux scores among the participants (n=49)

	n	%	Mean±SD	Min.-Max.
LPR				
Absent	32	65.3		
Present	17	34.7		
Reflux symptom index			9.43±4.81	0-20
Reflux finding scores			4.31±3.24	0-11

SD: Standard deviation; Min.: Minimum; Max.: Maximum; LPR: Laryngopharyngeal reflux.

Preoperative LMRS were significantly higher in patients with LPR based on Paired sample t-test (10.1±2.2 versus 8.3±2.7; p<0.020). Likewise, paired sample t-test showed that postoperative six-month LMRS were very significantly higher in patients with LPR (4.7±1.6 versus 2.4±1.0; p<0.001). Improvement in LMRS on six-month follow-up were very significant in both the LPR+ and LPR– groups (5.4±1.9 versus 5.9±2.3; p<0.001). Also Mann-Whitney U test showed no statistically significant difference between the improvements of radiology scores in LPR+ and LPR– groups (5.4±1.9 versus 5.9±2.3; p<0.619). The presence of acidic reflux was not a factor influencing the radiologic improvement after ESS (Table 4).

As for the SSQ, no statistically significant differences were found between sinusitis symptom scores of patients with or without LPR in either preoperative period (46.6±12.5 and 42.3±12.5 respectively; p<0.257) or at six-month follow-up (17.9±5.5 and 18.1±5.9 respectively; p<0.945). There was a statistically significant difference between pre- and postoperative six-month symptoms in both LPR+ and LPR– groups (Paired sample t-test; p<0.001). When comparing improvement in symptom scores, there was no statistically significant difference between LPR+ and LPR– groups with regard to the improvement in CRS symptoms after primary ESS (Table 4). Sinusitis symptoms improved significantly in either group after ESS. The presence of LPR was not a factor influencing the improvement of CRS symptoms after primary endoscopic surgery.

No statistically significant difference was found between preoperative endoscopy scores of the groups with regard to LPR (4.7±1.4 versus 4.6±1.4; p<0.661). However, paired sample t-test showed that postoperative six-month LKES were significantly higher (worse) in LPR+ patients (1.4±0.9 versus 0.9±0.7; p<0.012). Significant improvements were found between preoperative and postoperative six-month endoscopy scores in both the LPR+ and LPR– groups. However, no statistically significant difference was found between improvement scores of the groups with regard to the presence or absence of LPR (3.3±1.1 versus 3.7±1.3; p<0.321) (Table 4). The improvement in endoscopy scores after primary ESS was irrespective of the presence of reflux.

Surgery was scored according to the surgery scoring system.[6] Surgery scores on Mann-Whitney U test were significantly higher in patients with LPR (5.9±1.0 versus 5.1±1.1; p<0.026) (Table 4).

A correlation analysis was performed between RSI and LMRS, LKES or SSQ in all of the participants at six-month follow-up. No correlation was found between RSI and LMRS or SSQ at the sixth postoperative month. However, there was a statistically significant correlation between RSI and LKES in all participants, with endoscopy scores increasing related to RSI and vice versa (Pearson correlation coefficient, r=0.286; p<0.048), (Table 5).

Table 2. Distribution of preoperative and postoperative six-month Lund-Mackay, Lund-Kennedy and symptom scores of the patients

	Mean±SD	Min.-Max.
Preoperative Lund-Mackay scores	9.0±2.6	4.00-12.00
Postoperative Lund-Mackay scores	3.2±1.7	0.50-6.50
Preoperative Lund-Kennedy scores	4.6±1.4	1.50-6.00
Postoperative Lund Kennedy scores	1.1±0.8	0.00-3.50
Preoperative symptom scores	43.8±12.6	18-67
Postoperative symptom scores	18.0±5.7	9-32

SD: Standard deviation; Min.: Minimum; Max.: Maximum.

Table 3. Mean age and gender of the patients with and without laryngopharyngeal reflux

	Laryngopharyngeal reflux						
	Negative			Positive			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age			42.5±16.3			39.9±12.7	0.573*
Gender							
Female	12	37.5		8	47.1		0.732**
Male	20	62.5		9	52.9		

SD: Standard deviation; * Student t test; ** Yates continuity correction.

The correlation analysis between RFS and LMRS, LKES or SSQ demonstrated no statistical significance at six-months postoperatively (Pearson correlation coefficient; –0.233; –0.115; 0.065; p>0.05) (Table 6).

DISCUSSION

It has been well demonstrated through questionnaires and pH monitoring of GERD patients that gastric refluxate may reach the level of the laryngopharynx and nasal cavities, giving evidence of LPR findings on flexible laryngoscopy and CRS development on nasal endoscopy.[9] The extent of extraesophageal sequelae has been elucidated by the studies of Belafsky and documented by the assessment of otolaryngologic symptoms and laryngeal examination.[5] Following these reports, we aimed to carry out the present study using the parameters evaluated by Belafski et al.[4,5] and validated by numerous investigators.[10-12]

Recently the prevalence of reflux has been reported to be around 40% in children with recurrent rhinosinusitis.[13,14] Studies by DelGaudio[9] and Phipps et al.[15] revealed that gastric reflux may reach the level of the nasopharynx resulting in symptoms of CRS in 32% to 39% of patients. Furthermore, a higher prevalence of reflux (78% to 81.8%) has been noted in patients with CRS unresponsive to maximal therapy.[16,17]

Our results indicating a lower prevalence of LPR (34.7% in all CRS patients undergoing primary ESS) were unable to confirm the higher prevalence reported in the previous studies of Ulualp et al.[16] and DiBaise et al.[17]

Table 4. Pre- and postoperative six-month Lund-Mackay, Lund-Kennedy, symptom scores of the patients with and without preoperative laryngopharyngeal reflux (n=49)

	LPR (–) (n=31)			LPR (+) (n=17)			
	Mean±SD	Median	*p*§	Mean±SD	Median	*p*§	*p*†
Preoperative Lund-Mackay scores	8.3±2.7			10.1±2.2		0.001**	0.020*
Postoperative Lund-Mackay scores	2.4±1.0			4.7±1.6			0.001**
Improvement in Lund-Mackay scores (Difference)	5.9±2.3	5.50		5.4±1.9	5.50		0.619‡
Preoperative Symptom scores	42.3±12.5		0.001**	46.6±12.5		0.001**	0.257
Postoperative Symptom scores	18.1±5.9			17.9±5.5			0.945
Improvement in symptom scores (Difference)	23.9±12.1	24.00		28.6±10.9	28.00		0.171‡
Preoperative Lund-Kennedy scores	4.6±1.4		0.001**	4.7±1.4		0.001**	0.661
Postoperative Lund-Kennedy scores	0.9±0.7			1.4±0.9			0.012*
Improvement in Lund-Kennedy scores (Difference)	3.7±1.3	4.00		3.3±1.1	3.50		0.321
Surgery scores	5.1±1.1			5.9±1.0			0.026*‡

LPR: Laryngopharyngeal reflux; † Student t test; ‡ Mann-Whitney U test; § Paired sample t test; *p<0.05; ** p<0.01.

Table 5. Relation of Lund-Mackay, Lund-Kennedy and symptom scores with laryngopharyngopharyngeal reflux symptom index

LPR symptom index	*Total* (n=49)		LPR (–) (n=31)		LPR (+) (n=17)	
	r	*p*	r	*p*	r	*p*
Lund-Mackay scores	–0.189	0.197	–0.181	0.329	–0.116	0.657
Lund-Kennedy scores	–0.286	0.048*	–0.320	0.079	–0.044	0.865
Symptom scores	0.168	0.254	0.037	0.842	–0.001	0.998

LPR: Laryngopharyngeal reflux; r: Pearson correlation coefficient; * p<0.05

The difference in reflux prevalence between our study and earlier ones is probably related to different evaluation methods (pH monitoring versus flexible fiberoptic laryngoscopy) that may give rise to differences between results. However, besides experts who assert that pH monitoring is the gold standard for diagnosis of gastric reflux disease, there are others who suggest the yield on hypopharyngeal probes to be from 14% to 83% when all artefacts are excluded. However, with the use of aerosolized pH probes and reflux area index, it seems that the sensitivity of pH monitoring may have increased.[18,19]

Faced with patient resistance and intolerance to 24-hour pH impedance testing before undergoing ESS, our preferred diagnostic method was actually flexible fiberoptic laryngoscopy consistent with 75.7% of responders to questionnaire results of the American Broncho-Esophagological Association. Therefore the scoring system that we used for evaluating the presence of extraesophageal reflux relied on Belafsky scores (RSI and RFS).[4,7]

The primary measure of subjective outcome in the present study were the Sinusitis Symptom Questionnaire scores at baseline and in the long-term, compared with regard to reflux.[6] Our findings were only in partial agreement with recent studies.[1,9] We were not able to confirm the findings of Chambers et al.,[1] Hanna and Wormald,[2] and DelGaudio[9] who reported that patients with gastric reflux had higher scores on all sinusitis symptoms and a poor symptomatic outcome after ESS. However, although a statistically significant improvement was found between baseline and long-term symptoms both in LPR+ and LPR– groups, there was no significant difference in our patients' symptoms either at baseline or in the long-term with regard to the presence of reflux. Furthermore, improvement in symptoms that was not significantly different between LPR+ and LPR– groups (5.4±1.9 and 5.9±2.3 respectively) suggested that LPR was not a factor influencing symptomatic improvement in CRSsP treated with ESS. Discrepancies seen in symptomatic outcome between our study and these others may be explainable by differences between study populations. We chose patients undergoing primary ESS for CRSsP to minimize the additional effect of previous surgeries and polyposis on poor symptomatic outcome. However, patients with multiple ESS operations and with no specification of CRS subgroups (CRSsP or CRSwP) were included in the aforementioned studies.[1,2,9] In our opinion patients with CRSwP present worse outcomes than these with CRSsP and should not be included in the same population in studies evaluating the effect of LPR on CRS outcomes.

Table 6. Correlation analysis of reflux finding scores with Lund-Kennedy, Lund-Mackay and symptom scores

Reflux finding scores	*Total* (n=49)		LPR (–) (n=31)		LPR (+) (n=17)	
	r	*p*	r	*p*	r	*p*
Lund-Mackay scores	–0.233	0.111	–0.363	0.045*	0.011	0.967
Lund-Kennedy scores	–0.115	0.438	–0.096	0.606	0.195	0.454
Symptom scores	0.065	0.659	–0.269	0.143	0.120	0.646

r: Pearson correlation coefficient; * p<0.05

Preoperative radiology scores were significantly higher in patients with preoperative LPR in our study. Furthermore, radiology scores in the postoperative six-months were also very significantly higher in patients with LPR. Laryngopharyngeal reflux was a comorbidity associated with worse radiology scores at baseline and in the long-term in CRSsP. However, when considering similar radiologic improvement scores in LPR+ and LPR- groups, we may assert that gastric reflux does not seem to have a real effect on radiologic improvement after ESS. In our opinion it appears that LPR gives rise to worse radiology scores on presentation of CRSsP. Very likely poor radiologic outcome in the long-term seems to be the consequence of worse preoperative radiology scores.

The difference between mean surgery scores of LPR– and LPR+ groups was statistically significant. Preoperative LPR was associated with CRSsP that needed more extensive surgery.

With respect to the health of the sinonasal mucosa as assessed at the time of surgery, there was no significant difference between LKES in the LPR– and LPR+ groups on presentation. However, long-term endoscopy scores were significantly higher (worse) in LPR+ patients. As emphasized in previous reports, LPR was found to be associated with worse endoscopic scores in the long-term in our study.[2,20]

When comparing the difference between preoperative and long-term LKES (improvement in endoscopy scores), no significant difference was observed between groups after ESS (3.3±1.1; 3.7±1.3 for LPR+ and LPR– respectively). Similarly, acidic reflux was seen to have no effect on disease improvement in patients that were treated surgically for CRSsP.

The direct inflammatory effect of gastric refluxate and the direct role of *Helicobacter pylori* and activation of parasympathetic nerves in the sinonasal mucosa caused by hydrochloric acid stimulation of the esophagus are current hypotheses put forward to explain the contribution of acid reflux to the development of CRS.[21] Nevertheless, there are still a number of unresolved questions on the pathophysiological mechanism and treatment of CRS when it is related to LPR. Furthermore, some authors have expressed the view that treatment with H2 receptor antagonists or with PPI may not improve CRS symptoms to a significant extent.[22] This failure may be thought to originate from the multifactorial pathogenesis of CRS. Based on these considerations, and on the results derived from our data, we may assert that the negative effect of the reflux on the outcomes of primary ESS still remains a matter of debate. In line with these observations, even in LPR– patients, complete resolution of all radiologic, symptomatic and endoscopic findings was far from proven in our study.

The shortcoming of this study was the lack of 24-h pH testing to diagnose LPR and to define the level that the acid reached. However, we could not afford to cause additional patient discomfort before performing ESS. Consequently we relied on Belafsky scores by using flexible fiberoptic laryngoscopy (similar to 75.7% of experts in the USA) to verify the signs of LPR.

There is still much to discuss on the contributing role of LPR in the development and outcome of CRS. However, in our opinion, with regard to the vulnerability of the nasal mucosa coming into contact with gastric acid and activation of pepsinogen up to pH 7, every effort should be made to treat extraesophageal reflux associated with CRS and to develop a long acting pH neutralizer ointment that will cover and protect the nasal mucosa against the harm that the refluxate may give.

In conclusion, the results of this study support the association of LPR on presentation of CRSsP with worse endoscopic and radiologic scores. However, the improvement of sinusitis symptoms, endoscopy and radiology scores after primary ESS is irrespective of LPR.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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