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Laryngopharyngeal reflux leads to adverse short-term outcomes of vocal fold polyp patients after office-based transnasal vocal fold polypectomy

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Main Article

Yi Yang takes responsibility for the integrity of the content of the paper

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Abstract

Objectives. This study aimed to explore the influence of laryngopharyngeal reflux on the features of vocal fold polyps and prognosis after office-based transnasal vocal fold polypectomy.
Methods. Eighty-four vocal fold polyp patients were retrospectively analysed. Patients were assigned to laryngopharyngeal reflux or non-laryngopharyngeal reflux groups using pre-operative Reflux Symptom Score-12.
Results. The laryngopharyngeal reflux group had significantly higher pre-operative Reflux Sign Assessment scores, worse lifestyle and worse eating habits than the non-laryngopharyngeal reflux group. After office-based transnasal vocal fold polypectomy, the Reflux Symptom Score-12 and Reflux Sign Assessment score decreased in both groups, although the laryngopharyngeal reflux group still had higher values. The non-laryngopharyngeal reflux group had better vocal fold morphology recovery than the laryngopharyngeal reflux group. Multivariate logistic regression analysis demonstrated that smoking and a higher pre-operative Reflux Symptom Score-12 score were independent risk factors for poor prognosis.
Conclusions. Laryngopharyngeal reflux is detrimental to vocal fold recovery of vocal fold polyp patients following office-based transnasal vocal fold polypectomy. For vocal fold polyp patients with laryngopharyngeal reflux, lifestyle and diet guidance should be focused.

Introduction

Vocal fold polyps are the most common benign vocal fold lesions associated with voice disorders, frequently accompanied by hoarseness and dysphonia.[1] Recent studies indicate that 75 per cent of vocal fold polyp patients were combined with laryngopharyngeal reflux (LPR), an inflammatory condition of the upper aerodigestive tract tissues related to gastroduodenal content reflux.[2,3] Laryngopharyngeal reflux may induce phonotrauma, which is a main pathogenic factor and an important risk factor for adverse prognosis of vocal fold polyps.[4] Despite ongoing debate, some studies have suggested that the refluxes (e.g. acid and pepsin) had adverse effects on mucosal healing after vocal fold surgery, leading to scarring or recurrence of lesions.[5–7]

Currently, the primary surgical approaches for vocal fold polyps include the office-based transnasal vocal fold polypectomy and microlaryngoscopic surgery.[4] Although the two surgical techniques have exhibited similar overall efficacies for narrow-band and pedunculated vocal fold polyps, patients who underwent office-based transnasal vocal fold polypectomies experienced greater subjective symptom improvement during the initial post-operative phase.[4,8] Office-based transnasal vocal fold polypectomy has been applied more widely due to shorter operation time, better tolerability and less medical cost.[9] However, the influence of LPR on the prognosis of vocal fold polyp patients after office-based transnasal vocal fold polypectomy is inconclusive. In this study, we aimed to investigate the influence of LPR on the clinical features of vocal fold polyp patients and prognosis following office-based transnasal vocal fold polypectomy.

Materials and methods

Patients

Eighty-four patients diagnosed with vocal fold polyps who received office-based transnasal vocal fold polypectomies in the First Affiliated Hospital of Chongqing Medical University from September 2022 to April 2023 were retrospectively analysed. All patients were pathologically diagnosed with vocal fold polyps after the surgical procedures. Patients were excluded if they had: (1) upper respiratory tract infection within a month, (2) chronic rhinitis or sinusitis, (3) allergies or asthma, (4) gastroesophageal reflux, (5) current application of anti-reflux treatment, (6) history of head and neck malignancy or radiotherapy, or (7) history of vocal fold surgery. The Institutional Review Board

approved this study, and the requirement for informed consent was waived because of its retrospective design.

Study design

The detailed baseline characteristics were collected using a self-completing questionnaire. All patients received a flexible nasopharyngolaryngoscopy and voice analysis before the surgical procedure. The endoscope findings were classified and scored using the Reflux Sign Assessment.[10] Reflux Sign Assessment is subdivided into three parts: oral cavity, pharynx and larynx. The total score (0–72) is the sum of each item score. Voice analysis was performed in a room with noise < 45 dB. A professional voice and speech analysis system (lingWAVES, WEVOSYS, Bamberg, Germany) was used to test and analyse the acoustic parameters of jitter, shimmer, and maximum phonation time.

The assessment of LPR was performed using Reflux Symptom Score-12,[11] which is the short version of the Reflux Symptom Score.[12] Reflux Symptom Score-12 comprises seven ENT symptom items, three digestive items and two respiratory symptom items. For each item, the severity score is multiplied by the frequency score to get a symptom score (range = 0–25). The sum of these symptom scores is called the Reflux Symptom Score-12 total score (range = 0–300). In addition to the Reflux Symptom Score-12, a quality of life (QoL) score (range = 0–60) was calculated by summing its own items scores but not those symptom scores. In this study, the Chinese version of the Reflux Symptom Score-12, translated by Zheng *et al.*,[13] was used in which a Reflux Symptom Score-12 total score > 20 was considered a suggestion of LPR.

Surgical procedures

The procedures began with topical anaesthesia of the nasal cavity using a cotton pledget soaked with 1:10,000 epinephrine and 2 per cent lidocaine solution, followed by spraying 2 per cent lidocaine over the oropharynx. Patients were instructed to phonate a sustained 'e' sound when 2 per cent lidocaine was dripped into the laryngeal introitus. The 1.8-mm flexible biopsy forceps were used to remove the vocal polyp through the working channel of the laryngoscope. A 7-day voice rest period was prescribed post-operatively.

Follow up and study outcomes

Patients underwent follow up three months post-operatively by clinical assessment and flexible nasopharyngolaryngoscopy. The main outcomes included changes in the pre- and post-operative Reflux Sign Assessment and Reflux Symptom Score-12. In addition, laryngoscopic vocal fold morphology repairs were observed, including: (1) recovered morphology (smooth vocal fold without notable scar, Figure 1); (2) unrecovered morphology (scar or oedema of the vocal fold, Figure 2); and (3) polyp recurrence.

Statistical analysis

Summary results were presented as frequency (per cent) for categorical variables and mean ± standard deviation for continuous variables. Categorical variables were compared between groups using Pearson's chi-square test or Fisher's exact test. Continuous variables were compared with the Mann–Whitney U test. Variables found to be significantly associated with unrecovered morphology on univariable analysis ($p < 0.05$) were entered into the multivariable analysis. Logistic regression was performed on the multivariable analysis, and the results were presented with odds ratios and 95 per cent confidence intervals (CIs). A p-value < 0.05 was considered statistically significant. All statistical analyses were performed with SPSS (version 23; IBM, Armonk, NY, USA).

Results

Eighty-four vocal fold polyp patients with three-month follow ups were assigned to the LPR group ($n = 39$) and the non-LPR group ($n = 45$) depending on pre-operative Reflux Symptom Score-12 totals (Table 1). In addition to the total score, the otolaryngological, digestive, respiratory and QoL scores of LPR group were all significantly higher than those of the non-LPR group ($p < 0.05$). The pre-operative voice abuse and occupational exposure were similar in the two groups ($p > 0.05$). There were more smokers in the LPR group than in the non-PLR group (43.6 per cent *vs* 22.2 per cent, $p = 0.037$). More than half of the patients in both groups had poor eating habits, and patients with LPR had significantly higher proportions of late-night eating (35.9 per cent) and overeating (20.5 per cent) habits than non-LPR patients (15.6 per cent and 4.4 per cent, respectively, $p < 0.05$). For food-consumption habits, the LPR patients had a significantly higher rate of sugar-sweetened/carbonated beverage consumption than the non-LPR patients ($p = 0.007$). Pre-operative acoustic parameters (jitter, shimmer, and maximum phonation time) were comparable in the two groups. In addition, the Reflux

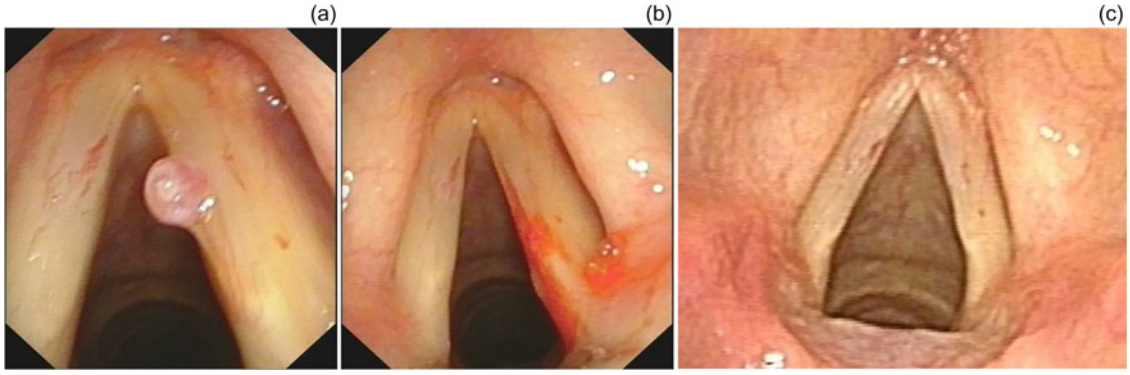

Figure 1. Laryngoscopic results in a patient whose vocal fold returned to normal. (A) Pre-operative laryngoscopy showed that a vocal fold polyp was located in the anterior and middle one-third of the right vocal fold. (B) Wound margins of the vocal fold were smooth after office-based transnasal vocal fold polypectomy surgery. (C) At three months following office-based transnasal vocal fold polypectomy surgery, laryngoscopy exhibited that the vocal folds were smooth with normal morphology.

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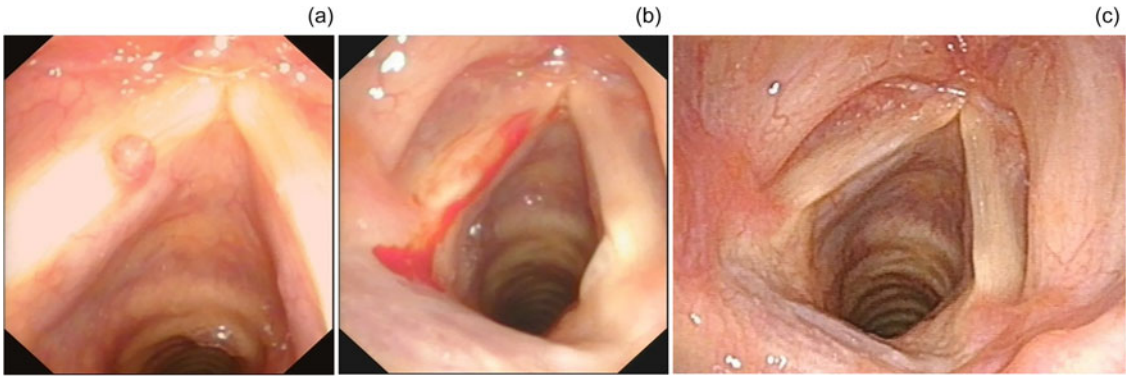

Figure 2. Laryngoscopic results in a patient with unrecovered vocal fold. (A) Pre-operative laryngoscopy showed that a vocal fold polyp was located in the anterior and middle one-third of the left vocal fold. (B) Wound margins of the vocal fold were smooth after office-based transnasal vocal fold polypectomy surgery. (C) At three months following office-based transnasal vocal fold polypectomy surgery, laryngoscopy exhibited a localized scar at the surgical field of the left vocal fold.

Sign Assessment total scores and three Reflux Sign Assessment-sub scores (oral, pharyngeal, and laryngeal scores) of the LPR group were significantly higher than those of the non-LPR group ($p < 0.05$), indicating that the vocal fold polyp patients with LPR had more pathologic signs.

Three months after office-based transnasal vocal fold polypectomy, all the post-operative Reflux Symptom Score-12 and Reflux Sign Assessment scores (sub- and total scores) in both LPR and non-LPR groups decreased significantly compared to the pre-operative assessment, except for the oral Reflux Sign Assessment score (Table 2). However, the post-operative scores of the LPR group were still significantly higher than those of the non-LPR group, except for the Reflux Symptom Score-12 respiratory score (Table 3). The LPR group also had less recovered morphology of vocal folds than non-LPR group (38.5 per cent *vs* 60 per cent, $p = 0.049$), while no polyp recurrence was observed in either group.

In the univariate analysis for risk factors influencing vocal fold morphology recovery, male, higher BMI, voice abuse, smoking, alcohol consumption, coffee/tea intake, late-night eating, higher consumption of junk food, carbonated beverages and spicy food, higher Reflux Symptom Score-12, and Reflux Sign Assessment scores were identified as factors associated with a worse recovery of the vocal folds ($p < 0.05$, Table S1). Multivariate logistic regression analysis was then performed on these factors, demonstrating that smoking (odds ratio = 11.012, 95 per cent CI = 1.344–90.230, $p = 0.025$) and a higher pre-operative Reflux Symptom Score-12 total score (odds ratio = 1.067, 95 per cent CI = 1.027–1.108, $p = 0.001$) were independent risk factors for a worse recovery of vocal folds.

Discussion

No polyp recurrence was observed in the short-term in patients following office-based transnasal vocal fold polypectomy. However, half of the vocal fold polyp patients included (42/84) had poor recovery of vocal fold morphology, with scars or oedemas. Multivariate analysis demonstrated that smoking and a higher pre-operative Reflux Symptom Score-12 total score were independent risk factors for poor vocal fold morphology repair. The Reflux Symptom Score-12 score is an effective indicator to evaluate the presence and severity of LPR. Compared with the Reflux Symptom Index,[14] which has been used to diagnose LPR, the Reflux Symptom Score,[12] developed in 2019, had higher sensitivity and specificity for the diagnosis of LPR, providing a more comprehensive assessment on otolaryngologic, digestive, and respiratory reflux symptoms. The shortened version of the Reflux Symptom Score (Reflux Symptom Score-12), developed by Jerome *et al.*,[11] maintained good sensitivity and specificity, and has been gradually cited and verified.

Similarly, in the comparation between the prognosis of vocal fold polyp patients combined with or without LPR, the LPR group had significantly more unrecovered morphology. Although the Reflux Sign Assessment scores in both groups decreased after office-based transnasal vocal fold polypectomy, values of the LPR group were still significantly higher than for the non-LPR group. These findings indicate that LPR had detrimental effects on the vocal fold recovery and pathological signs of improvement of vocal fold polyp patients following office-based transnasal vocal fold polypectomy. The potential mechanism may be that pepsin alters defence mechanisms of the vocal folds, hindering mucosal healing and epithelialisation process after vocal cord surgery.[6,15] Meng *et al.*[5] indicated that patients with negative pepsin in vocal fold polyps had better post-operative recovery of vocal fold morphology and acoustic efficacy than those with positive pepsin. In addition, some studies have reported that surgery combined with anti-reflux treatment led to better epithelization, improving the reflux symptoms and voice quality of vocal fold polyp patients.[6,7]

- Laryngopharyngeal reflux was common in patients diagnosed with vocal fold polyps
- Vocal fold polyp patients combined with laryngopharyngeal reflux had worse lifestyle and eating habits than those vocal fold polyp patients without laryngopharyngeal reflux
- Smoking and the severity of laryngopharyngeal reflux were independent risk factors for poor vocal fold morphology recovery of vocal fold polyp patients following office-based transnasal vocal fold polypectomy

This study indicates that vocal fold polyp patients combined with LPR presented worse dietary and life habits than those without LPR, including more smoking, worse late-night eating and overeating habits, and more frequent sugar-sweetened/carbonated beverage consumption. Smoking induces LPR by loosening the lower and upper oesophageal sphincters and delaying gastric emptying.[16,17] In addition, high-sugar and high-acid foods and beverages are associated with proximal reflux, increasing the laryngopharyngeal exposure to acid or other reflux contents.[18] Poor eating habits (i.e. fast eating, overeating, and late-night eating) have also been demonstrated to increase the risk of LPR.[19] To improve the overall prognosis of vocal fold polyp patients after office-based transnasal vocal fold polypectomy, maintaining good dietary and lifestyle habits (i.e. quitting smoking and

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Table 1. Characteristics of patients in non-LPR and LPR groups before operation; LPR = laryngopharyngeal reflux; BMI = body mass index; MPT = maximum phonation time; QoL = quality of life; RSS-12 = Reflux Symptom Score-12; RSA = Reflux Sign Assessment.

Parameters	non-LPR Group ($n = 45$)	LPR Group ($n = 39$)	p value
Gender (n, %)			0.705
Male	12, 26.7%	9, 23.1%	
Female	33, 73.3%	30, 76.9%	
Age (y)	45.87 ± 7.95	43.38 ± 7.42	0.157
BMI (kg/m^2)	23.62 ± 2.60	23.94 ± 2.65	0.467
Voice abuse (n, %)	27, 60%	30, 76.9%	0.098
Occupational exposure (n, %)	10, 22.2%	8, 20.5%	0.849
Smoking (n, %)	10, 22.2%	17, 43.6%	0.037
Drinking (n, %)	12, 26.7%	6, 15.4%	0.209
Coffee/tea drinking (n, %)	6, 13.3%	9, 23.1%	0.245
Poor eating habits (n, %)	24, 53.3%	25, 64.1%	0.318
Late-night eating	7, 15.6%	14, 35.9%	0.032
Fast eating	15, 33.3%	16, 41.0%	0.466
Overeating	2, 4.4%	8, 20.5%	0.039
Frequency of junk food/week (n, %)			0.170
0~2	39, 86.7%	33, 84.6%	
3~5	6, 13.3%	3, 7.7%	
> 5	0, 0%	3, 7.7%	
Frequency of sugar-sweetened/ carbonated beverages/week (n, %)			0.007
0~2	42, 93.3%	26, 66.7%	
3~5	2, 4.4%	6, 15.4%	
> 5	1, 2.2%	7, 17.9%	
Frequency of spicy food/week (n, %)			0.697
0~2	26, 57.8%	19, 48.7%	
3~5	11, 24.4%	11, 10.2%	
> 5	8, 17.8%	9, 23.1%	
Jitter (%)	1.36 ± 0.74	1.53 ± 0.63	0.078
Shimmer (%)	9.66 ± 3.47	9.09 ± 4.37	0.058
MPT (s)	7.34 ± 2.23	6.54 ± 2.02	0.098
Reflux Symptom Score-12			
Otolaryngological score	12.60 ± 6.48	40.69 ± 20.47	< 0.001
Digestive score	0.27 ± 0.58	0.92 ± 1.40	0.007
Respiratory score	0.07 ± 0.25	2.23 ± 5.39	0.002
QoL score	2.40 ± 1.51	6.38 ± 5.59	< 0.001
RSS-12 total score	12.93 ± 6.24	43.85 ± 23.17	< 0.001
Reflux Sign Assessment			
Oral score	1.27 ± 1.41	2.23 ± 1.60	0.002
Pharyngeal score	4.33 ± 3.61	8.38 ± 4.89	< 0.001
Laryngeal score	8.69 ± 3.94	11.31 ± 4.59	0.002
RSA total score	14.29 ± 7.12	21.92 ± 8.16	< 0.001

alcohol, avoiding late-night eating and overeating, and decreasing sugar-sweetened/carbonated beverage consumption) after procedures should be advised.

This study has some limitations. First, the study cohort was small, with only three months of follow-up outcomes reported. Second, the study is a retrospective single-centre study, potentially introducing selection bias. Third, we did not use the 24-hour multichannel intraluminal impedance and pH monitoring, considered the gold standard for diagnosing LPR, because it is an invasive and expensive method that is not yet widely applied in clinics. Nevertheless, the diagnostic efficiency of Reflux Symptom Score-12 for LPR has been verified, mitigating the influence on results to some extent.

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Table 2. Comparison between pre-operative and three-month post-operative RSS-12 (Reflux Symptom Score-12) and RSA (Reflux Sign Assessment) scores in non-LPR and LPR groups; LPR = laryngopharyngeal reflux; QoL = quality of life.

	non-LPR Group			LPR Group		
	Pre-operative	Post-operative	*p* value	Pre-operative	Post-operative	*p* value
Reflux Symptom Score-12						
Otolaryngological score	12.60 ± 6.48	2.27 ± 3.43	< 0.001	40.69 ± 20.47	14.46 ± 14.49	< 0.001
Digestive score	0.27 ± 0.58	0.07 ± 0.25	0.024	0.92 ± 1.40	0.62 ± 0.94	0.006
Respiratory score	0.07 ± 0.25	0	0.083	2.23 ± 5.39	0	0.002
QoL score	2.40 ± 1.51	0.40 ± 0.81	< 0.001	6.38 ± 5.59	2.23 ± 3.33	< 0.001
RSS-12 total score	12.93 ± 6.24	2.33 ± 3.50	< 0.001	43.85 ± 23.17	15.08 ± 14.26	< 0.001
Reflux Sign Assessment						
Oral score	1.27 ± 1.41	1.27 ± 1.41	> 0.999	2.23 ± 1.60	2.23 ± 1.60	> 0.999
Pharyngeal score	4.33 ± 3.61	3.93 ± 4.09	0.043	8.38 ± 4.89	7.46 ± 5.07	0.033
Laryngeal score	8.69 ± 3.94	6.24 ± 4.48	< 0.001	11.31 ± 4.59	9.62 ± 3.86	< 0.001
RSA total score	14.29 ± 7.12	11.44 ± 8.24	< 0.001	21.92 ± 8.16	19.31 ± 7.86	< 0.001

Table 3. Comparison of post-operative RSS-12, RSA scores and laryngoscopic vocal fold morphologies between non-LPR and LPR groups; LPR = laryngopharyngeal reflux; QoL = quality of life; RSS-12 = Reflux Symptom Score-12; RSA = Reflux Sign Assessment

	non-LPR Group	LPR Group	*p* value
Reflux Symptom Score-12			
Otolaryngological score	2.27 ± 3.43	14.46 ± 14.49	< 0.001
Digestive score	0.07 ± 0.252	0.62 ± 0.94	< 0.001
Respiratory score	0	0	> 0.999
QoL score	0.40 ± 0.81	2.23 ± 3.33	< 0.001
RSS-12 total score	2.33 ± 3.50	15.08 ± 14.26	< 0.001
Reflux sign assessment			
Oral score	1.27 ± 1.41	2.23 ± 1.60	0.002
Pharyngeal score	3.93 ± 4.09	7.46 ± 5.07	0.001
Laryngeal score	6.24 ± 4.48	9.62 ± 3.86	0.002
RSA total score	11.44 ± 8.24	19.31 ± 7.86	< 0.001
Post-operative morphologies of laryngoscopic vocal folds			0.049
Recovered morphology with smooth vocal fold, without notable scar	27, 60%	15, 38.5%	
Unrecovered morphology, including scar or oedema of vocal fold	18, 40%	24, 61.5%	
Polyp recurrence	0 (0.0%)	0 (0.0%)	

Conclusion

The presence and severity of LPR are detrimental to vocal fold recovery and pathological signs improvement of vocal fold polyp patients following office-based transnasal vocal fold polypectomy. In addition to the treatment of vocal fold polyp, the management of LPR (i.e. anti-reflux medication, lifestyle and diet guidance) should be advised.

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Competing interests. The authors declare none.

Ethical statement and informed consent. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of The First Affiliated Hospital of Chongqing Medical University. The requirement for informed consent was waived because of the retrospective design.

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