

# A STUDY ON EUSTACHIAN TUBE DYSFUNCTION IN CHRONIC LARYNGOPHARYNGEAL REFLUX PATIENTS: PROSPECTIVE OBSERVATIONAL STUDY

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## Abstract

The primary objective of this research was to investigate whether chronic laryngopharyngeal reflux disease contributes to Eustachian tube dysfunction. A prospective observational study was carried out on 107 patients with chronic laryngopharyngeal reflux disease admitted to the outpatient department of Otorhinolaryngology at Saveetha Medical College and Hospital Chennai from August 2020 to June 2022. The epidemiological data regarding age, sex, and symptoms were recorded. Laryngopharyngeal reflux was diagnosed based on the reflux symptom index (RSI) and rigid video laryngoscopy findings, namely, the reflux finding score (RFS). Eustachian tube function was assessed by using impedance audiometry. Patients ranged from 18 to 65 years. A total of 37.4% (37 patients) had Type A curves, 13.1% (17 patients) had Type B curves, 44.9% (47 patients) had Type C curves, 2.8% (5 patients) had Ad curves, and 1.9% (2 patients) had As type curves on tympanograms. A positive correlation was observed between chronic laryngopharyngeal reflux disease and eustachian tube dysfunction on the tympanogram. The data collected from this study show that Eustachian tube dysfunction can be considered an indicator of the initiation of anti-reflux treatment. Such data are useful for early identification and treatment, allowing for more targeted and effective management of patients with chronic laryngopharyngeal reflux disease by addressing the underlying cause of dysfunction.

**Keywords:** Chronic Laryngopharyngeal Reflux, Eustachian Tube Dysfunction, Tympanogram, Impedance Audiometry, Gastro Oesophageal Reflux Disease.

## INTRODUCTION

Laryngopharyngeal reflux disease (LPRD) was first described by von Leden and Moore in the 1960s, but it did not come to the forefront of otolaryngology until Koufman's landmark thesis on this subject in 1991[1,2]. Laryngeal abnormalities may be caused either by direct injury by acid reflux or damage by a secondary mechanism [3-5].

It has been shown experimentally that a few to three reflux episodes per day can cause severe laryngeal mucosal damage and subsequent damage to the nasopharyngeal mucosa, leading to Eustachian tube dysfunction due to damage to the cilia [1].

The reflux of gastric acid and pepsin into the middle ear and Eustachian tube can cause mucosal inflammation, leading to Eustachian tube dysfunction. The symptoms include ear fullness, tinnitus or popping discomfort/pain for more than 3 months in chronic cases of Eustachian tube dysfunction [6-8].

We can hypothesize, with the support of the literature [6-9], that Eustachian tube dysfunction and resulting middle ear consequences are related to extra oesophageal reflux.

In this study we aimed to determine whether chronic laryngopharyngeal reflux disease is a contributing factor to Eustachian tube dysfunction.

## Aim and Objective

AIM: To determine whether chronic laryngo pharyngeal reflux disease contributes to Eustachian tube dysfunction.

OBJECTIVE: To evaluate eustachian tube status in patients with chronic laryngo pharyngeal reflux disease using impedance audiometry.

## MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Otorhinolaryngology at Saveetha Medical College and Hospitals Chennai from August 2020 to June 2022. This study was performed to assess eustachian tube function in patients with chronic laryngopharyngeal reflux disease (LPRD). This study was approved by the Institutional Review Board and Ethical Committee of Saveetha University (SMC/IEC/2020/09/038) and the study was conducted in accordance with ethical standards established by the Declaration of Helsinki (2000). All patients were informed about the study and written informed consent was obtained prior to participation. The sampling method utilized was nonprobability convenience sampling. A total of 107 patients were included in this study. Our primary objective was to investigate the relationship between Eustachian tube function and LPRD in patients with no known nasal pathology.

The inclusion criterion was as follows:

- Aged between 18 and 65 years.
- Patients who experienced symptoms of laryngopharyngeal reflux disease for more than 6 weeks with a score greater than 13 on the reflux symptom index questionnaire (RSI) and a score greater than 7 on the reflux finding score (RFS) determined via endoscopy.

Exclusion Criteria:

- Aged younger than 18 years and older than 65 years
- Patients with previous barotrauma, which causes dysfunction of the eustachian tube, tinnitus persisting for more than six months, sensorineural and mixed hearing loss, oto-sclerosis, maxillofacial malformations, and middle and inner ear malformations.
- Patients with a history suggestive of allergic rhinitis or nonallergic rhinitis or who were chronic smokers. Patients with chronic rhinosinusitis (CRS) according to the sinonasal outcome test-22 scoring system were excluded.
- Patients not willing to participate in the study.

## Research Design:

All participants aged 18 to 65 years who met the inclusion and exclusion criteria were enrolled in the study. Participants were diagnosed with LPRD based on the reflux symptom index (RSI) and rigid video laryngoscopy findings namely, the reflux finding score (RFS). A nine-item questionnaire [Table.1] was administered to calculate the reflux symptom index (RSI) for the assessment of symptoms in patients with LPRD. The scale for each individual item ranged from 0 (no problem) to 5 (worst possible problem), with a maximum score of 45.

**Table 1: Reflux Symptom Index (RSI) Questionnaire [14]**

Symptoms	No	Minimal	Mild	Moderate	Severe	Worst
Hoarseness or problem with your voice	0	1	2	3	4	5
Clearing your throat	0	1	2	3	4	5
Excess throat mucus or post nasal drip	0	1	2	3	4	5
Difficulty in swallowing food, liquids or pills	0	1	2	3	4	5
Coughing after you ate or after lying down	0	1	2	3	4	5
Breathing difficulties or choking episodes	0	1	2	3	4	5
Troublesome or annoying cough	0	1	2	3	4	5
Sensations of something sticking or lump in your throat	0	1	2	3	4	5
Heartburn, chest pain, indigestion or stomach acid coming up	0	1	2	3	4	5

Video laryngoscopy was performed on the selected patients. A rigid video laryngoscope was utilized for visualization of the larynx and pharynx. During video laryngoscopy, specific findings associated with laryngo pharyngeal reflux (LPR) were meticulously observed and documented systematically according to the reflux finding score (RFS) system [Table.2].

**Table 2: Reflux Finding Score [15]**

Subglottic oedema	0-Absent		2-Present		
Ventricular obliteration		2-Partial			4-Complete
Erythema/Hyperraemia		2*			4-Complete
Vocal fold oedema		1-Mild	2-Moderate	3-Severe	4-Polypoidal
Diffuse laryngeal oedema		1-Mild	2-Moderate	3-Severe	4-Obstructive
Posterior commissure hypertrophy		1-Mild	2-Moderate	3-Severe	4-Obstructive
Granuloma/Granulation tissue	0-Absent		2-Present		
Thick endo-laryngeal mucus	0-Absent		2-Present		

\*only arytenoids involvement

The findings included subglottic oedema, ventricular obliteration, erythema / hyperaemia, vocal cord oedema, diffuse laryngeal oedema, posterior commissure hypertrophy, thick endo-laryngeal mucus and granuloma/granulation tissue.

A diagnosis of LPRD was made if the RSI was greater than 13 and the laryngoscopic findings (RFS) were greater than 7. Eustachian tube function was assessed by using impedance audiometry. Limitations of the study was not using the gold standard investigation dual probe pH monitoring.

All the data including patient demographics, RSI scores, video laryngoscopy findings, and corresponding RFS grades, were collected, and data tabulation was performed using MS Excel. IBM SPSS v26 was used for the statistical analysis. Descriptive statistics were used to summarize the distribution of RFS grades and their correlation with RSI scores.

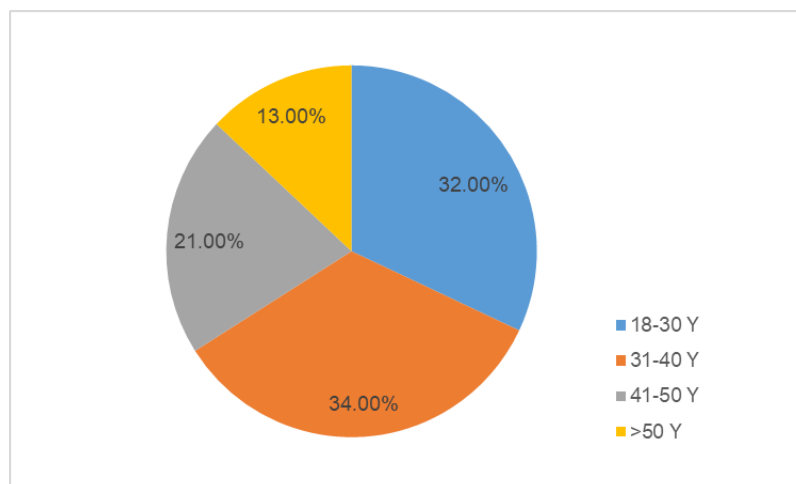
## RESULTS

There were 107 patients in the 18 to 65year-old age group, with a mean age of 39±11.3years, who were divided into groups of patients aged 18-30 years, 31-40 years, 41-50 years and more than 50 years [Table.1].

**Table 1: Distribution of Patients According to Age**

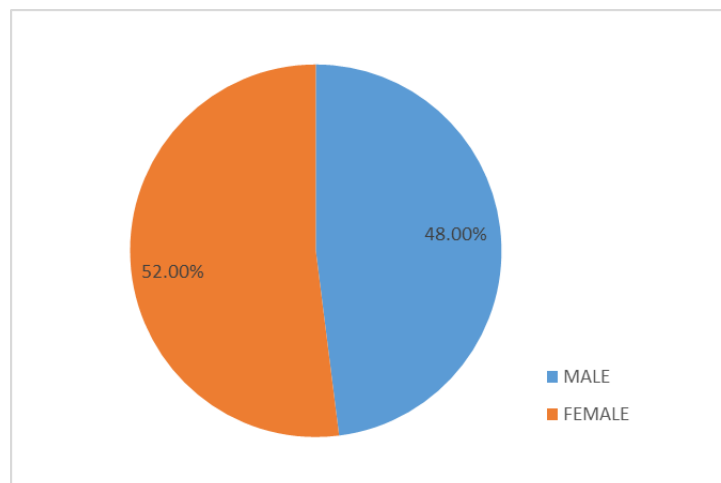
Age in years	Frequency	Percentages
18-30 years	34	32%
31-40 years	36	34%
41-50 years	23	21%
>50 years	14	13%
<b>Total</b>	<b>107</b>	<b>100%</b>

Most of the patients included in the study were individuals aged 31 to 40 years 34% (36 patients), and fewest included individuals aged more than 50 years 13% (14 patients) [Fig.1].



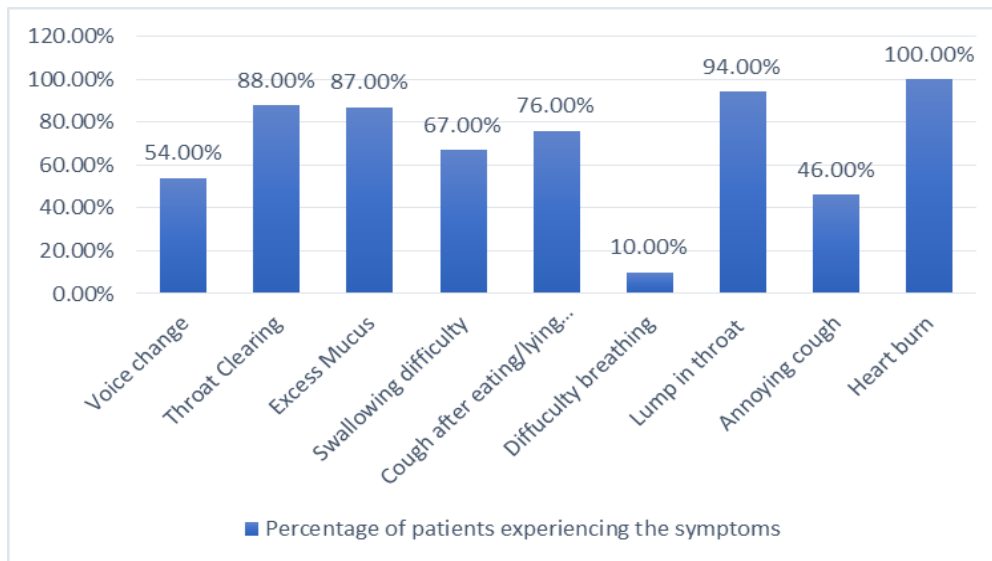
**Figure 1: Pie Chart Showing the Distribution of Patients According to Age**

The majority of the patients who presented with symptoms of laryngopharyngeal reflux disease were male 52% (56 patients), and 48% (51 patients) were female [Fig.2].



**Figure 2: Pie Chart Showing the Distribution of Patients According to Sex**

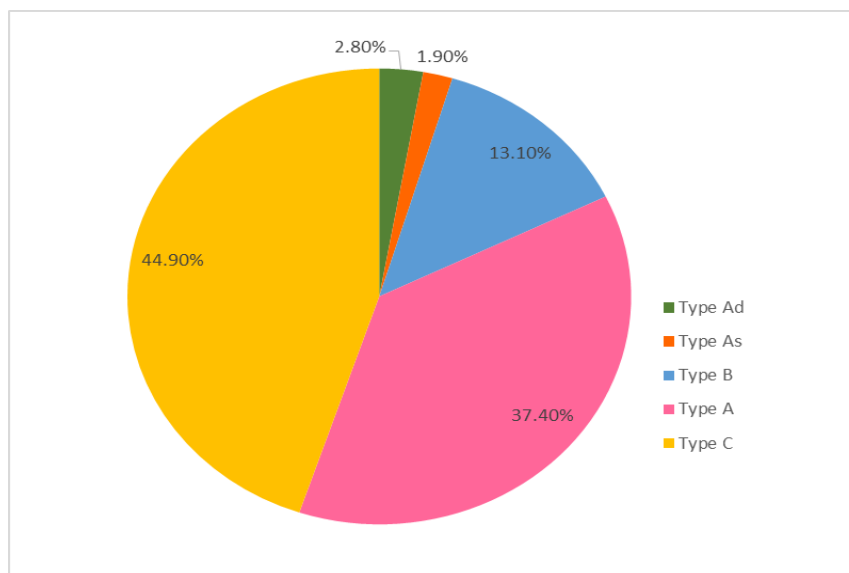
In this study the reflux symptom indices of 54% of patients had changes in voice, 88% of patients had throat clearing, 87% of patients complained of excessive throat mucus, 67% had difficulty swallowing, 76% had cough after eating or lying down, 10% had breathing difficulty or choking episodes, 46% had an annoying cough, 94% had a lump sensation in the throat, and almost all the patients had symptoms of heartburns or indigestion [Fig.3].



**Figure 3: Clustered Column Chart Showing the Distribution of Patients based on Symptoms Experienced as per the Reflux Symptom Score**

According to the reflux finding score, 2% of the patients had subglottic edema, 61% had ventricular obliteration, 89% had erythema/hyperemia, 60% had mild vocal cord edema, 59% had diffuse laryngeal edema, 73% had mild posterior commissure hypertrophy, 76% had thick endolaryngeal mucus, and no patients had granuloma/granulation tissue on video laryngoscopy.

Eustachian tube dysfunction was measured by using impedance audiometry in this study 37.4% (37 patients) had Type A curves, 13.1% (17 patients) had Type B curves, 44.9% (47 patients) had Type C curves, 2.8% (5 patients) had Ad curves, and 1.9% (2 patients) had As type curves on tympanograms [Fig.4].



**Figure 4: Pie Chart Showing the Distribution According to Impedance Audiometry Findings**

The gender distribution of the impedance audiometry data showed that 54.9% (28 female patients) and 44.6% (25 male patients) of the patients had type A curves on the tympanogram. A total of 11.8% (6 female patients) and 14.3% (8 male patients)

had type B curves on tympanograms. A total of 31.4% (16 female patients) and 37.5% (21 male patients) of patients had type C curves on tympanograms.

A total of 29.4% (10 patients) were younger than 30 years, 40% (20 patients) were between the ages of 31 and 45 years, and 30.4% (7 patients) were older than 45 years and had type C curves on tympanograms. Chi square test value in accordance with the age of the patients is  $<0.05$ . Hence our study showed a positive correlation between LPRD and Eustachian tube dysfunction on tympanogram.

## DISCUSSION

The eustachian tube is a ventilation passage connecting the middle ear cavity to the nasopharynx that adjusts middle ear pressure, ventilation and drainage [10]. Eustachian tube dysfunction is attributed to a number of etiological factors. Eustachian tube obstruction is not just a cause of LPRD, in contrast, LPR can also cause Eustachian tube dysfunction because reflux material from the stomach can reach the nasopharynx and into the Eustachian tubes, thereby blocking the tubes directly or causing inflammation and adhesion and collapse. On analysing the confounding factors, the chi-square test values in accordance with exposure to the risk factors affecting Eustachian tube function were as follows, 0.486 for smoking, with a standard deviation of  $4.309 \pm 0.718$ , 0.343 for alcohol, with a standard deviation of  $4.318 \pm 0.776$ , 0.781 for tobacco chewing, with a standard deviation of  $3.925 \pm 1.014$ , 0.897 for caffeine intake, with a standard deviation of  $3.934 \pm 0.402$  and 0.716 for fast food and spicy food intake, with a standard deviation of  $3.872 \pm 0.548$ . The most common risk factor these patients were caffeine intake followed by alcohol consumption followed by smoking.

Magliulo et al showed that impaired mucociliary clearance due to LPRD can itself be a causative factor for eustachian tube dysfunction in these patients [11]. In our study, we used impedance audiometry to observe ET dysfunction in patients with symptoms of LPRD. Our study revealed that 37.4% (37 patients) of patients had Type A curves, 13.1% (17 patients) had Type B curves, 44.9% (47 patients) had Type C curves, 2.8% (5 patients) had Ad curves, and 1.9% (2 patients) had As type curves on tympanograms. Hence our study revealed a positive correlation between chronic LPRD and ET dysfunction on tympanography, as there could be various other factors affecting the Eustachian tube in an individual. The study had some limitations that need to be addressed. First, no further confirmatory research has explored the effect of antireflux therapies on improving ET function. The use of diagnostic gold standard investigation multiprobe oesophageal pH monitoring could have been used to prove its relation to the reflux symptom index [12, 13].

## CONCLUSION

In summary, this study evaluated patients with chronic laryngopharyngeal reflux disease to assess Eustachian tube dysfunction. Significant results were obtained in these patients in regard to Eustachian tube dysfunction. The parameters studied were affected in both sexes and predominantly in the male working class age group. Certain lifestyle habits are considered to be risk factors for laryngopharyngeal reflux disease. The duration of exposure can be proportional to the severity of disease. Hence eustachian tube dysfunction can be considered an indicator for antireflux treatment.

## References

- 1) Koufman JA. The Otolaryngologic Manifestations of Gastroesophageal Reflux Disease (GERD): A Clinical Investigation of 225 Patients Using Ambulatory 24-Hour pH Monitoring and an Experimental Investigation of the Role of Acid and Pepsin in the Development of Laryngeal. *The Laryngoscope*. 1991 Apr;101:1–78. <https://doi.org/10.1002/lary.1991.101.s53.1>
- 2) Sataloff RT, Hawkshaw MJ, Gupta R. Laryngopharyngeal reflux and voice disorders: an overview on disease mechanisms, treatments, and research advances. *Discov Med*. 2010 Sep;10(52):213-24. PMID: 20875343.
- 3) Vaezi MF. Sensitivity and specificity of reflux-attributed laryngeal lesions: experimental and clinical evidence. *Am J Med*. 2003 Aug 18;115 Suppl 3A:97S-104S. [https://doi.org/10.1016/s0002-9343\(03\)00205-5](https://doi.org/10.1016/s0002-9343(03)00205-5)
- 4) Adhami T, Goldblum JR, Richter JE, Vaezi MF. The role of gastric and duodenal agents in laryngeal injury: an experimental canine model. *Am J Gastroenterol*. 2004 Nov;99(11):2098-106. PMID: 15554987. <https://doi.org/10.1111/j.1572-0241.2004.40170.x>
- 5) Ing AJ, Ngu MC, Breslin AB. Pathogenesis of chronic persistent cough associated with gastroesophageal reflux. *Am J Respir Crit Care Med*. 1994 Jan 149(1):160-7. PMID: 8111576. <https://doi.org/10.1164/ajrccm.149.1.8111576>
- 6) Brunworth JD, Mahboubi H, Garg R, Johnson B, Brandon B, Djalilian HR. Nasopharyngeal acid reflux and Eustachian tube dysfunction in adults. *Ann Otol Rhinol Laryngol*. 2014 Jun;123(6):415-9. PMID: 24671547. <https://doi.org/10.1177/0003489414526689>
- 7) Formánek M, Zeleník K, Komínek P, Matoušek P. Diagnosis of extraesophageal reflux in children with chronic otitis media with effusion using Peptest. *Int J Pediatr Otorhinolaryngol*. 2015 May;79(5):677-9. Epub 2015 Feb 19. PMID: 25736547. <https://doi.org/10.1016/j.ijporl.2015.02.013>
- 8) Schilder AG, Bhutta MF, Butler CC, Holy C, Levine LH, Kvaerner KJ, Norman G, Pennings RJ, Poe D, Silvola JT, Sudhoff H, Lund VJ. Eustachian tube dysfunction: consensus statement on definition, types, clinical presentation and diagnosis. *Clin Otolaryngol*. 2015 Oct;40(5):407-11. PMID: 26347263; PMCID: PMC4600223. <https://doi.org/10.1111/coa.12475>
- 9) Sone M, Kato T, Nakashima T. Current concepts of otitis media in adults as a reflux-related disease. *Otol Neurotol*. 2013 Aug;34(6):1013-7. PMID: 23851353. <https://doi.org/10.1097/mao.0b013e318299aa52>
- 10) Bluestone CD, Doyle WJ. Anatomy and physiology of eustachian tube and middle ear related to otitis media. *J Allergy Clin Immunol*. 1988 May;81(5 Pt 2):997-1003. PMID: 3286738. [https://doi.org/10.1016/0091-6749\(88\)90168-6](https://doi.org/10.1016/0091-6749(88)90168-6)
- 11) Magliulo G, de Vincentiis M, Iannella G, Ciofalo A, Manno A, Pasquariello B, Angeletti D, Pace A, Gulotta G, Polimeni A. Eustachian tube evaluation in patients with obstructive sleep apnea syndrome. *Acta Otolaryngol*. 2018 Feb;138(2):159-164. Epub 2017 Oct 9. PMID: 28990834. <https://doi.org/10.1080/00016489.2017.1385846>
- 12) Cumpston EC, Blumin JH, Bock JM. Dual pH with Multichannel Intraluminal Impedance Testing in the Evaluation of Subjective Laryngopharyngeal Reflux Symptoms. *Otolaryngol Head Neck Surg*. 2016 Dec;155(6):1014-1020. Epub 2016 Aug 23. PMID: 27554506. <https://doi.org/10.1177/0194599816665819>
- 13) Plocek A, Gębora-Kowalska B, Białek J, Fendler W, Toporowska-Kowalska E. Esophageal Impedance-pH Monitoring and Pharyngeal pH Monitoring in the Diagnosis of Extraesophageal Reflux in Children. *Gastroenterol Res Pract*. 2019 Mar 3;2019:6271910. PMID: 30944563; PMCID: PMC6421743. <https://doi.org/10.1155/2019/6271910>
- 14) Abraham ZS, Kahinga AA. Utility of reflux finding score and reflux symptom index in diagnosis of laryngopharyngeal reflux disease. *Laryngoscope Invest Otolaryngol*. 2022 Apr 22;7(3):785-789. PMID: 35734054; PMCID: PMC9194976. <https://doi.org/10.1002/2Fluo.2.799>
- 15) Belafsky PC, Postma GN, Koufman JA. The Validity and Reliability of the Reflux Finding Score (RFS). *The Laryngoscope*. 2001 Aug; 111(8):1313–7. <https://doi.org/10.1097/00005537-200108000-00001>