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Original Research Article

Role of preoperative tympanometric evaluation of eustachian tube in patients undergoing type-1 tympanoplasty for chronic otitis media

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ABSTRACT

Background: A dysfunctional eustachian tube can cause failure of middle ear pressure regulation which leads to chronic otitis media and tympanoplasty failure. The functional status of eustachian tube can non-invasively be assessed prior to tympanoplasty by impedence audiometry. This help to predict the outcome of the procedure as well as aid surgeons to plan the surgery accordingly. The aim of the study was to determine the role of pre-operative tympanometric evaluation of eustachian tube function in patients with chronic otitis media.
Methods: This study was conducted on 42 patients with chronic otitis media underwent type-1 tympanoplasty in department of otorhinolaryngology, Government Medical College, Kottayam over a period of one year. Detailed history, clinical and audiological evaluation done. Type-1 tympanoplasty performed and reassessed after 3 months. Data compiled and analysed using SPSS.
Results: Intra-operative findings were similar to the audiometric results. Majority of patients with dysfunctional eustachian tube got a non-satisfactory hearing outcome compared to patients with good eustachian tube function, and this comparison is statistically significant with p value 0.006. The graft uptake in patients with dysfunctional eustachian tube is poor compared to patients with good eustachian tube function, which is statistically significant with p value 0.013.
Conclusions: Impedence audiometer can very reliably assess and ascertain eustachian tube dysfunction pre-operatively. The outcome of type-1 tympanoplasty in patients with eustachian tube dysfunction is uniformly poor. Better outcome probably would be gained by using more resilient materials like cartilage.

Keywords: Chronic otitis media, Eustachian tube function, Tympanoplasty, Impedence audiometry

INTRODUCTION

Chronic otitis media is the chronic inflammation of the middle ear and mastoid cavity which is a complex multifactorial disease. The etiological factors proposed are varied ranging from genetics, race and environment to autoimmune disease.[1]

Despite controversies regarding the exact mechanisms, the pathophysiology of otitis media most certainly relates to dysfunction of the eustachian tube and failure of middle ear pressure regulation. A dysfunctional eustachian tube hence can also causes tympanoplasty failure by primarily affecting middle ear pressure dynamics and secondarily via recurrent otitis due to poor tubotympanic mucociliary drainage.[2,3]

The main functions of eustachian tube are middle ear ventilation, drainage of secretion from middle ear and protection of middle ear from nasopharyngeal secretions and pathogens.[4,5] The impedance audiometer offers the best mode of assessing the eustachian tube function as it measures the function with both intact as well as in perforated tympanic membranes with distinct advantage of being non-invasive. By knowing the status of eustachian tube prior to the surgery, surgeon can predict

the probable outcome of the procedure to some extent; same can also be included in the consent form which is significantly important in medico-legal aspect. Moreover, pre-operative evaluation of eustachian tube function will help the surgeon to choose the proper graft material.

The objective of this study was to assess the role of pre-operative tympanometric evaluation of eustachian tube function in patients with chronic otitis media undergoing type-1 tympanoplasty. Assessment of the status of eustachian tube function prior to tympanoplasty by impedence audiometry can predict the outcome of the procedure as well as aid surgeons to plan the surgery accordingly.

METHODS

Type of study

The study type was descriptive study (observational).

Period of study

The study period was 1 year from February 2018-2019.

Study setting

All cases who were diagnosed to have chronic suppurative otitis media and who underwent surgery for the same in department of otorhinolaryngology, Government Medical College, Kottayam during 1 year study period.

Sample size was calculated by using the data from a previous study conducted by Joshi et al on 'tympanometry-a prognostic indicator of myringoplasty with assessment of eustachian tube function'.

In that study 87.5% of patients with good eustachian tube function had successful surgical outcome in terms of graft uptake, absence of otorrhea and improvement in hearing. Using this data, minimum sample size for the study is calculated using the formula:

$$N = \frac{Z\alpha 2PQ}{d^2}$$

Zα=1.96; d=relative precision; P=prevalence, N=sample size

$$Q = 1 - P$$

Where P=87.5, Q=12.5, d=10

$$N = \frac{1.96 \times 1.96 \times 87.5 \times 12.5}{100}$$

Therefore, 42 patients were included in this study.

Inclusion criteria

Patients with following criteria were included (a) central perforation; (b) no foci of infection for two months; (c) no comorbidities; (d) age above 18 years; and (d) who were undergoing type-1 tympanoplasty.

Exclusion criteria

Patients with (a) congenital anomalies like cleft palate; (b) serous otitis media; (c) allergic rhinitis; (d) sensorineural hearing loss; (e) active infection; and (f) revision surgery.

After approval from scientific review committee, institutional ethical committee clearance was obtained and the study was initiated in February 2018. Informed consent was obtained from the participants. Confidentiality was ensured and maintained throughout the study. A thorough history was taken and clinical examination done. It includes otoscopic examination, Tuning fork tests and nasopharyngeal examination done using post-nasal mirror to assess the eustachian tube orifice. Pure tone audiometric evaluation done to confirm the clinical findings, to identify patients with poor cochlear reserves and to exclude them from the study population. This was followed by eustachian tube function evaluation using impedance audiometer. Toynbee's test for perforated tympanic membrane was preferred. Then patients grouped into subjects having good Eustachian tube function and poor eustachian tube function based on the test results. Type-1 tympanoplasty performed in all subjects under local anesthesia. Temporalis fascia used as graft material. Intra-operatively the eustachian tube orifice of the operating ear is examined under microscope. Post-operatively the patients followed up and reassessed after 3 months. Clinical history taken regarding persistence of symptoms. Hearing outcome assessed by patient's subjective perception of improvement, whether better than, same as or worsen than the preoperative status. Graft uptake assessed by otoscopic examination. The correlation between the Eustachian tube function and surgical outcome then studied and evaluated.

The data was entered in Microsoft excel and analysed using SPSS (statistical package for the social sciences). Chi square test was used to analyse the result for statistical significances for qualitative variables the level of statistical significance was p value less than or equal to 0.05.

RESULTS

The results of our study are presented in Table 1-4. Age group of the studied population ranges from 20-53 years. The study population consists of 13 males and 29 females. In the total population 73.8% had good eustachian tube function and 26.2% had dysfunctional Eustachian tube according to preoperative impedance audiometry. Intra-operative findings were similar to the audiometric results.

It was found that in patients with bilateral COM has more chance of eustachian tube dysfunction compared to those with unilateral disease. On postoperative follow-up majority of patients with dysfunctional Eustachian tube got a non-satisfactory hearing outcome compared to patients with good eustachian tube function, and this comparison is statistically significant with p value 0.006. The graft uptake in patients with dysfunctional eustachian tube is poor compared to patients with good eustachian tube function, which is statistically significant with p value 0.013.

Table 1: Distribution according to pre-operative eustachian tube status in tympanometry.

Eustachian tube function	Frequency	Percentage
Blocked	11	26.2
Patent	31	73.8
Total	42	100.0

Table 2: Association of eustachian tube status with bilateral ear disease.

Parameters	Eustachian tube status		Total	P value
	Blocked	Patent		
Unilateral	**N**	3	30	33	<0.01
	%	9.1	90.9	100.0	
Bilateral	**N**	8	1	9	
	%	88.9	11.1	100.0	

Table 3: Association of eustachian tube status with hearing outcome.

Parameters	Eustachian tube status		Total	P value
	Satisfactory	Non- Satisfactory		
Blocked	**N**	3	8	33	<0.006
	%	27.3	72.7	100.0	
Patent	**N**	23	8	9	
	%	74.2	25.8	100.0	

Table 4: Association of eustachian tube status with graft uptake.

Eustachian tube status	Graft uptake		Total	P value
	Satisfactory	Non- Satisfactory		
Blocked	**N**	5	6	11	0.013
	%	45.5	54.5	100	
Patent	**N**	26	5	31	
	%	83.9	16.1	100	

DISCUSSION

Even though the association of COM with eustachian tube dysfunction is well established, the role of eustachian tube function in the successful outcome of tympanoplasty remains controversial. Among the previous studies conducted on this subject, some demonstrated a correlation between poor eustachian function and graft failure, but some failed to show any relation. So the role of eustachian tube function in the outcome of tympanoplasty needs further studies. Since type 1 tympanoplasty is the simplest form of tympanoplasty and require minimal surgical expertise, it's outcome is least affected by the factors like technique, experience of the surgeons etc. Thus, preoperative assessment of ET functions seems important in predicting the outcome of type-1 tympanoplasty. The present study aims to evaluate the role of Eustachian tube function in outcome of type 1 tympanoplasty by assessing the pre-operative and intraoperative eustachian tube status and post-operative outcomes.

This study was conducted on 42 patients underwent type-1 tympanoplasty; of these 11 were had poor eustachian tube function. Since proper functioning of eustachian tube is essential for middle ear ventilation and good mucociliary drainage, an adequately functioning eustachian tube can be consider as a favorable prognostic factor in the outcome of middle ear surgery. Impedence audiometry is a simple, non-invasive method to assess the pressure equalisation function of eustachian tube, which is more important function in the pathogenisis of COM. A pre-operative assessment of tubal function is therefore provides an idea of probable outcome, ie, chance of achieving a satisfactory result following tympanoplasty. Eustachian tube tube function status using impedance audiometer is similar to intraoperative assessment.

In this study 9 patients had bilateral ear disease, out of which 8 patients had Eustachian tube dysfunction and among the 11 patients with eustachian tube dysfunction 8 had bilateral ear disease(81.8%), similar to the findings of Joshi et al. They found that 83.33% with poor Eustachian tube function had bilateral chronic otitis media.[6]

There is a statistically significant association with p value of 0.01 between eustachian tube function and graft uptake. Among 31 patients with good eustachian tube function, 26 had good graft uptake (83.9%) and among the 11 patients with poor eustachian tube function only 5 had good graft uptake (45.4%), correlating with findings of previous studies

In a study conducted by Cohn et al by assessing ETF by using impedance audiometry, those with normal ETF showed a graft uptake of 95% and only 69% graft uptake in those with totally impaired ETF.[7] The study conducted by Shiromani et al on showed 90.2% successful outcome in patients with normal ETF while only 63.6% with partial dysfunction of ET.[3] In a similar study conducted by Pandey et al 80% of patients with normal eustachian tube function had good surgical outcome whereas only 50% with non-functioning eustachian tube had satisfactory result.[8] Srivastava et al also observed a positive correlation between the ETF and outcome of the surgery in their study comprising 100 patients with COM. In that 91.1% of cases with normal ETF had good graft take up rate whereas the rate was only 65.62% in cases with impaired ETF.[9]

Holmquist et al tested eustachian tube function in 72 cases and showed that in the group with good tubal function 75% had good outcome and in the hypo-function group almost 90% had poor outcome.[10]

Guindy et al in their study showed that the success rate of graft uptake in patients with normal tubal function was 95% and success rate in patients with tubal dysfunction was 90% and success rate in patients with poor tubal function was 68%.[11] Sato et al examined in 77 ears subjected to type 1 tympanoplasty and eustachian tube function was evaluated by positive and negative pressure equalization tests, and clearance test. Based on the results they classified the subjects into four grades and stated that the chance of unsuccessful outcomes increased with the grade of tubal dysfunction. They concluded that tubal function is closely associated with the outcome of ear surgery.[12]

The success of the tympanoplasty in patients with unilateral COM was found to be more than the bilateral CSOM, may be because of the associated eustachian tube dysfunction in bilateral disease. This shows that eustachian tube function plays a major role in the graft uptake.

The association between the eustachian tube function and hearing improvement is also statistically significant with p value of 0.006. Among the 31 patients with good eustachian tube function 23 had satisfactory hearing improvement (74.2%) whereas among the 11 patients with poor eustachian tube function only 3 had satisfactory results (27.3%). In the 8 patients with unsatisfactory hearing outcome, 2 had satisfactory graft uptake. This is correlating with study by MacKinnon et al among the 43 cases with poor eustachian function 24 (56%) had good hearing outcome compared to 30 (81%) in 37 cases with good eustachian tube function.[13]

However this is a study comprising of only 42 patients as the duration of study is only 1 year and some of the patients didn't come for the follow up visits, hence got excluded from the study. Better results might have been obtained if duration of study is prolonged. It is advisable to do a pre-operative eustachian tube function assessment in patients who undergoing tympanoplasty to obtain an idea about the possible outcome, proper patient counselling, modification of surgical procedure and to choose the proper graft material.

CONCLUSION

The main functions of eustachian tube are middle ear ventilation, drainage of secretion from middle ear and protection of middle ear from nasopharyngeal secretions and pathogens. Eustachian tube dysfunction is a significant predisposing factor for chronic otitis media .Though Eustachian tube dysfunction is seen in unilateral chronic otitis media it predominantly causes bilateral middle ear disease. Impedence audiometer can very reliably assess and ascertain eustachian tube dysfunction pre-operatively. The outcome of type-1 tympanoplasty in patients with eustachian tube dysfunction is uniformly poor in terms of graft uptake and hearing improvement. Better outcome probably would be gained by using more resilient materials like cartilage.

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