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Original Research Article

Study of postoperative outcome following tympanoplasty by using middle ear risk indices: an observational study

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ABSTRACT

Background: Chronic otitis media is a very common disease worldwide, particularly in developing countries. Tympanoplasty is the most commonly performed surgical treatment for chronic otitis media. The likelihood of a good outcome after surgery and the severity of the condition are evaluated using the Middle Ear Risk Index (MERI). Aim of our study is to assess the outcome following tympanoplasty by using the MERI in terms of uptake of graft and audiological gain.
Methods: Prospective observational study conducted in Department of Otorhinolaryngology at tertiary care centre included 54 patients of mucosal type of CSOM who underwent tympanoplasty. Risk categorization based on MERI scale was done. Data was collected and analyzed statistically.
Results: Out of 54 patients, 42 had mild MERI score, 10 had moderate and 2 had severe MERI score. Among those with mild MERI score, graft acceptance was 95.24% (40 patients), with a rejection rate of 4.76% (2 patients) and 92.85% (39 patients) had an audiological gain suggesting that patients with low MERI scores have greater hearing benefit after surgery. The overall success rate of tympanoplasty is 87.04% according to graft status and hearing benefit.
Conclusions: In the present study, patients with lower MERI risk scores had better prognosis in terms of graft acceptance, improvement in hearing and also in achieving good A-B gap closure as compared with success rate in severe MERI score.

Keywords: Middle ear risk index, Post operative outcome, Tympanoplasty

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a chronic inflammatory process of the mucoperiosteal lining of the middle ear cleft, composed of Eustachian tube, attic, aditus and mastoid air cells and is characterized by recurrent ear discharge through a tympanic membrane perforation.[1] The world health organization (WHO) estimated that 65–330 million people worldwide are affected by CSOM.[2] The management of CSOM includes aural toilet, antibiotic therapy to control infection, surgery of existing pathological conditions and surgical repair of tympanic membrane. Tympanoplasty is the standard surgical procedure for the treatment of Chronic otitis media. In this surgical technique, repair of perforated tympanic membrane is done with/without reconstruction of ossicles.[3] The primary goal of the surgery is to eradicate the disease and restore tympanic aeration, while the secondary purpose is to reconstruct the hearing mechanism.[4] With a large number of patients frequently undergoing tympanoplasty for chronic otitis

media, it is important to assess the severity of the disease and predict the outcome of the surgical management to avoid any unrealistic expectations and possible medicolegal implications.[5] There are various prognostic measures that predicts the success of tympanoplasty in terms of hearing improvement and graft uptake, but they lack uniformity in assessing the predictors that influence the result.[6]

Kartush et al developed the middle ear risk index (MERI) method in 1994, which gives a numerical value corresponding to disease severity and the chance of a favorable outcome after surgery.[7] It is an amalgamation of the Austin-Kartush classification of ossicular defects, the Belluci classification of otorrhoea, as well as the presence of tympanic membrane perforation, middle ear granulation and cholesteatoma.[8] MERI was initially scored 0-12, but was later amended in 2001 to include smoking and increase the weightage for granulation and cholesteatoma, resulting in a score of 0-16.[9]

Many previous studies in the literature have found good correlation between MERI and success of tympanoplasty, showing low MERI having a good surgical outcome.[5] In this study, we used the MERI to stratify patient in groups and evaluated the efficacy of the MERI score in assessing the outcome of tympanoplasty in terms of graft uptake and postoperative gain in hearing threshold.

METHODS

This is a prospective observational study conducted at department of otorhinolaryngology at Government Medical college and hospital, Akola including 54 patients who underwent tympanoplasty from October 2022 to March 2024. The cases were selected as per laid down inclusion and exclusion criteria.

Inclusion criteria

All cases of safe chronic suppurative otitis media with conductive type of hearing loss above the 10 years of age willing for surgery.

Exclusion criteria

Patients who lost to follow-up before 3 months. Institutional Ethical Committee clearance and informed written consent was taken prior to study.

Detailed history was obtained from the patient such as the nature of ear discharge, the period of dryness, hearing loss, other medical illness, history of smoking, previous ear surgery and long-term use of ototoxic drugs. As per protocol, Otoscopy, otoendoscopy and Otomicroscopy done to document the findings of tympanic membrane in detail. To assess the hearing, tuning fork test and pure tone audiometry was done. The middle ear risk index was calculated. Based on modified MERI score, patients were stratified into those with mild (0-3), moderate (4-6) and severe (≥7) MERI (Table 1).[9]

All the patients underwent tympanoplasty by using postaural approach and temporalis fascia as the graft material and intraoperatively ossicular chain status was documented. Patients were called for follow up for 3 months (15th day, 1 month, 2 months, 3 months) postoperatively.

At the end of 3 months, the anatomical and functional outcomes of surgery were evaluated in terms of graft uptake and audiological gain and were compared in group of patients with mild, moderate and severe MERI. Successful uptake of the graft was seen only in those patients who had no residual perforation.

The audiological gain was considered as the closure of the air-bone gap (AB gap). AB gap was calculated as the mean of air-bone gap at three frequencies (500Hz, 1000Hz and 2000 Hz) preoperatively and postoperatively at 3 months. The audiological gain was derived for each patient by subtracting the post-op AB gap from the pre op AB gap. Audiological gain>20 dB was taken as a success; 11-20 dB was taken as improvement and <10 dB no improvement.[12]

The data was collected and analysed statistically using Microsoft excel 2021 and Jamovi software v.2.4.11.

RESULTS

The current study was conducted in the Department of Otorhinolaryngology at a tertiary care centre comprised of 54 patients with mucosal type CSOM who underwent tympanoplasty between October 2022 and March 2024. The findings are as follows:

In this study, the most common age group affected is 21-30 years, followed by 31 to 40 years (Table 2). This study comprises of 12 males and 42 female patients with M:F ratio of 1:3.5. Thus females constitute 77.86 % of the study population.

Based on preoperative hearing status assessed by PTA, maximum patients had mild to moderate hearing loss (Table 3). The patients were categorized based on their MERI score, study group comprises 42 patients with mild (1-3) MERI score, 10 patients with moderate (4-6) MERI score and 2 patients with severe (≥ 7) MERI score. The successful graft uptake was seen in 47 patients (87.04%) and rejected in 7 patients (12.96%). Thus the overall success rate of tympanoplasty is 87.04 % according to graft status. Among those with mild MERI (n=42), graft is taken up in 40 patients (95.24%) and rejected only in 2 patient (4.76%) while in severe MERI score (n=2) graft was taken up by 1 patient (50%) and rejected by 1 patient (50%). On applying Chi-square test, the association was found to be statistically significant ($p<0.05$) (Table 4).

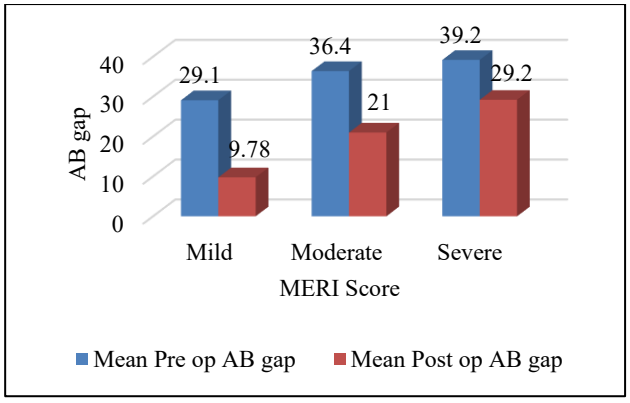

Figure 1: Comparison of mean pre and post-operative AB gap in the three MERI groups.

Among n=54 operated ears, 12.96% (n=7) had ossicular necrosis, in which 6 patient underwent type 3 tympanoplasty and 1 patient underwent type IV tympanoplasty. Among those who underwent tympanoplasty type 3 (n=6), graft acceptance was observed in 3 patients (50%). There were 3 patients with history of smoking in the study group. Out of 3 patients, in 2 cases graft was rejected. In the study, there is 100% graft acceptance in dry ear (n=2), 90% in occasionally wet ear (n=30) and 81.81% in persistently wet ear (n=30). On applying Chi-square test, the association between Bellucci's criteria and graft uptake was found to be not statistically significant (p>0.05) (Table 5).

Among the people with mild MERI, the mean pre-op AB gap and post-op AB gap were 29.1±6.47 and 9.78±6.85 respectively. In moderate MERI group, the mean pre-op AB gap and post-op AB gap were 36.4±7.30 and 21.0±9.27 respectively. In severe MERI, the mean pre-op AB gap and post-op AB gap were 39.2±1.18 and 29.2±8.25 respectively (Figure 1).

In the study, the overall hearing benefit based on AB gap closure is observed in 87.04% patients. Out of 42 participants who had mild MERI score, 39 (92.86%) participants had an audiological gain. Out of 10 participants who had a moderate MERI score, 7 (70%) participants had an audiological gain. In severe MERI score (n=2), 1 participant (50%) had audiological gain. On applying Chi-square test, the association was found to be statistically significant (p<0.05) (Table 6).

Table 1: Middle ear risk index 2001.

Risk factors	Risk value
Otorrhea	
Dry	0
Occasionally wet	1
Persistently wet	2
Wet with cleft palate	3
Perforation	
Absent	0
Present	1
Cholesteatoma	
Absent	0
Present	2
Ossicular chain	
M+ I+ S+	0
M+ S+	1
M+ S-	2
M- S+	3
M- S-	4
Ossicular head fixation	2
Stapes fixation	3
Middle ear granulation/ effusion	
No	0
Yes	2
Previous surgery	
None	0
Staged	1
Revision	2
Smoker	
No	0
Yes	2

Table 2: Age distribution of study group.

Age (in years)	No. of patients
11-20	6 (11.11%)
21-30	17 (31.57%)
31-40	15 (27.86%)
41-50	10 (18.52%)
51-60	6 (11.11%)

Table 3: Distribution of study group based on ASHA classification of hearing impairment.

ASHA classifications	Hearing loss (dB HL)	No. of patients
Mild CHL	26-40	22 (40.74%)
Moderate CHL	41-55	29 (53.70%)
Moderately-severe CHL	56-70	3 (5.56%)
Severe CHL	71-90	0
Profound CHL	>90	0

Table 4: Association between MERI score and graft uptake.

MERI scores	Graft status			Chi-square value	P value
	Total	Graft accepted	Graft rejected		
Mild	42	40	2	11.4	0.003
Moderate	10	6	4		
Severe	2	1	1		
Total	54	47	7		

Table 5: Association between Bellucci's criteria and graft uptake/rejection.

Otorrhoea	Graft status			Chi-square value	P value
	Total	Graft accepted	Graft rejection		
Dry	2 (3.70%)	2	0	1.06	0.588
Occasionally wet	30 (55.56%)	27	3		
Persistently wet	22 (40.74%)	18	4		

Table 6: Association between severity of MERI score and audiological gain.

MERI scores	No. of cases	Audiological gain			Chi-square value	P value
		Yes		No		
		Successful (Gain >20 dB)	Improvement (Gain 11- 20 dB)	Not improved (Gain <10dB)		
Mild	42	18	21	3	6.27	0.044
Moderate	10	5	2	3		
Severe	2	0	1	1		

Table 7: Inference of the various studies reviewed.

S. no	Author	No. of patients	Correlation of MERI with	Outcome
1	Nallapaneni et al[24]	75	Graft uptake and pre-operative and post- operative PTA	Increase MERI, lowers the graft uptake, decreases hearing benefit post-operatively
2	Verma et al[25]	200	Graft uptake and hearing improvement	Lower the MERI score better the outcome
3	Singh et al[26]	90	Graft uptake and hearing improvement	Lower the MERI, better the outcome
4	Sharma et al[11]	50	Hearing improvement in terms air-bone (A-B) gap	Lower the MERI score better the outcome of A-B gap

Continued.

S. no	Author	No. of patients	Correlation of MERI with	Outcome
5	In present study	54	Graft uptake and hearing improvement	Lower MERI risk scores had better prognoses in terms of graft acceptance, improvement in hearing and also in achieving good A-B gap closure.

DISCUSSION

Chronic otitis media is a very common disease worldwide, particularly in developing countries. despite extensive research and development of new surgical techniques, the outcomes of surgery vary due to disease progression and various factors. Establishing a uniform system for predicting surgery outcomes and providing appropriate counselling is crucial in developing countries where the cost of surgery and absence of work are major issues. Among the different systems used, middle ear risk index is one such system which takes into account of both pre operative and intra operative findings of middle ear to predict the outcome of surgery. This study was conducted to evaluate a group of patients with mucosal type CSOM who underwent tympanoplasty with reference to the prognostic value of MERI.

The study population comprised 54 patients, aged 11 to 60, with a higher proportion of females (77.86%) than males. Study conducted by Basak et al and Kalyanasundaram et al were also showing female predominance however, in a study done by Abhinav et al the disease was more common in males (60.31%).[14-16] The study found that mucosal type of COM is more common in the 21-40 age group, possibly due to increased awareness of health issues and hearing difficulties, which affect work efficiency and prompt patients to seek early intervention. This finding aligns with previous studies of Pinar et al and Indorewala et al indicating a higher prevalence in the 3rd and 4th decade of life.[6,17]

On assessment of preoperative hearing status, 40.74% of patients had mild hearing loss, 53.70% had moderate hearing loss and only 5.56% had moderately severe hearing loss, similar to a previous study done by Muftah et al.[18] The MERI combines the known preoperative and intra operative risk factors for tympanoplasty prognosis into a numeric value. It also allows meaningful study comparisons by delineating essential data and stratifying cases within various prognostic categories. In the study (n=54), 77.78% cases (n=42) were classified as mild, 18.52% (n=10) as moderate and 3.70% (n=2) as severe MERI score. In a study conducted by Kumar et al 36 (72%) patients had mild MERI score, 12 (24%) patients had moderate MERI score and 2 (4%) patients had severe MERI score.[5,19] During the study period, 54 patients underwent tympanoplasty, with 87.04% success rate in terms of graft uptake. The best outcomes were observed in ears with mild disease (MERI 1-3) i.e., 95.24% followed by MERI 4–6 moderate disease i.e., 60% and in ears with MERI score of 7–12 i.e., severe disease only 50% has accepted the graft. On applying Chi-square test, the association was found to be statistically significant ($p<0.05$). As the MERI score goes on increasing, there were more chances of graft rejection. In study conducted by Pinar et al MERI score ($p=0.000$) was found to be statistically significant prognostic factor that affects success rate 6. According to Sarfaraz et al and Tabassum et al 93.11% success was seen with mild MERI score. 80.55% with moderate MERI score and 62.85% with severe MERI score.[10]

Previous studies have reported smoking to be of prognostic importance and it was added in MERI 2001.[9] The reasons why smoking impacted the hearing outcomes negatively might be 2-fold, one the long-term tobacco exposure may impair mucociliary clearance function 20; two the vasoconstrictor effects of nicotine possibly compromised the blood supply of the newly grafted drum. In the study, on correlating history of smoking with graft uptake, 66.67% of smokers experienced graft failure, while only 9.80% of non-smokers experienced it. Becvarovski et al found that delayed graft uptake was more common in smokers (60%) than non-smokers (20%).[9] According to Krishna et al smoking status has little effect on tympanoplasty success.[21]

According to Bellucci classification of ear discharge, 90% graft acceptance was seen in occasionally wet ear (n=30) and 81.81% in persistently wet ear (n=22). On applying Chi-square test, the association was found to be not statistically significant ($p>0.05$). Similar to study, Dornhoffer et al shows that Bellucci classification was not statistically significant overall.[22] When it comes to status of ossicles, cases with intact ossicles with only perforation of TM gives better surgical outcomes.[5] Majority of the cases (n=47) belonged to this category and they underwent type 1 tympanoplasty. Pre operative and postoperative audiometric pattern of study population were compared and the amount of air bone gap closure achieved was noted. The study found that individuals with mild MERI showed better postoperative improvement in the AB gap compared to those with severe MERI, with a mean pre-op AB gap of 29.1±6.47 and 39.2±1.18 to mean post-op AB gap of 9.78±6.85 and 29.2±8.25 respectively. This finding is consistent with previous studies by Lima et al and Kumar et al which also reported similar postoperative mean AB gap improvements.[3,5] The overall hearing benefit in the study was observed in 87.04 % patients which is comparable to the study done by Vignadutt et al in which they found overall hearing improvement in 84% cases.[23] Among the

study participants, the audiological gain was highest in mild MERI group (92.85%) and lowest in severe MERI group (50%) (Table 7). On applying Chi-square test, the association was found to be statistically significant ($p<0.05$). Hence, patients with a mild MERI score have higher chances of hearing improvement and patients with severe MERI score has lower chances for hearing improvement.

This study has certain limitations like, the sample size was small, eustachian tube function not assessed and all the surgeries were not done by a single surgeon.

CONCLUSION

Tympanoplasty is a beneficial procedure for closure of perforation and hearing improvement in the treatment of COM. MERI scoring serves as an important tool for assessing the severity of COM cases and prognostic factors for predicting outcomes after surgery. It has an inverse relation with graft uptake and hearing benefit. Lower MERI risk scores had better outcome in terms of graft a as compared with success rate of severe MERI score. Being a simple assessment and prognostic tool, MERI scoring can be made a part of the surgical workup for every case of COM. The likelihood of surgical outcome and hearing benefit could be explained to the patient of COM to give them realistic expectations on the basis of MERI score. Preoperative factors like otorrhea, granulation and smoking can be addressed and treated accordingly in order to reduce the MERI score which in turn improve the outcome of surgery.

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