

# Middle Ear Risk Index [MERI] as Prognostic Factor in Tympanomastoidectomy with Tympanoplasty

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## Abstract

**Aims:** To evaluate a group of patients undergoing surgery for chronic otitis media with reference to the prognostic value of middle ear risk index and other factors in predicting the anatomical and functional outcome of tympanomastoidectomy with tympanoplasty.

**Subjects:** The study comprised of 90 patients suffering from chronic otitis media with or without cholesteatoma. Patients attending the Otorhinolaryngology out patients department were considered for this study.

**Methods:** The patients underwent tympanomastoidectomy with tympanoplasty in which mastoidectomy performed was of either canal wall up or canal wall down technique. In cholesteatoma surgery, whenever possible a canal wall up procedure was performed. Myringoplasty was done using autologous temporalis fascia graft by underlay technique. Middle ear risk index [MERI] and other factors were evaluated for their outcome predictive role in patients undergoing tympanomastoidectomy with tympanoplasty.

**Results:** Outcomes were evaluated in terms of tympanic membrane graft uptake and post operative mean audiological gain. The Middle ear risk index was also found to be significant predictor of the outcome of surgery. The patients with mild MERI scores had significantly better prognosis than the patients with severe MERI scores.

**Conclusion:** The Anatomical and Functional outcome of tympanomastoidectomy with tympanoplasty is diversely affected by the pathological and technical factors associated with disease and its management. A better understanding of these factors is helpful for better prognostication of the factors affecting the disease and in planning the surgical procedure.

**Keywords:** Middle ear risk index; Tympanomastoidectomy; Tympanoplasty; Chronic otitis media; Prognostic factors; Canal wall up; Canal wall down

## Introduction

The primary objective of surgery for chronic otitis media (COM) is to eradicate the disease and to make the ear safe and dry. The incidence of the ears becoming dry

after surgery and the ears not having recurrent or residual cholesteatoma ranges between 70 to 90 percent in various large clinical trials<sup>[1]</sup>. A second objective of surgery for COM is to restore hearing to serviceable levels by means of tympanoplasty. There has been a difference in opinion about the staging of the surgical procedure for COM. Some studies supported the single stage surgery for both elimination of disease and tympanoplasty<sup>[2,3]</sup>. Whereas others advocate two stage procedure for achieving the different objectives<sup>[4,5]</sup>. Tympanomastoidectomy is the procedure for removal of disease from middle ear cleft done either as open or closed cavity procedure, and

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tympanoplasty is the procedure for reconstruction of the middle ear. The suggested risk categories can be derived from MERI as follows:

MERI 0 = Normal; MERI 1-3 = Mild disease; MERI 4-6 = Moderate disease; MERI 7-12 = Severe disease [9].

## **Material and Methods**

This study has been carried out in the Department of Otorhinolaryngology, Saraswathi institute of medical sciences, Hapur, U.P., India from January 2016 to November 2019. The study comprised of 90 patients suffering from chronic otitis media with or without cholesteatoma. The age of patients ranged from 7 to 46 years and male to female sex ratio of 1.3:1. The patients were subjected to detailed history, general as well as systemic examination, which includes clinical examination of the ear, nose, paranasal sinuses, larynx and pharynx. The complete otological evaluation has been done to assess the exact nature and extent of disease, presence or absence of tympanosclerosis, cholesteatoma, granulation tissue, mucosal polyp and ossicular chain status. In cholesteatoma surgery, whenever possible a canal wall up procedure was performed. Canal wall down technique was done in cases having extensive disease, erosion of the external auditory meatus, or revision surgery for extensive recurrent disease. CWU procedure was done in 67 patients and CWD procedure was done in 23 patients. In our study of 90 patients, 68 patients were having tympanic membrane perforation and 22 patients were having retraction pockets. Out of 68 patients, 8 patients were having anterior perforation, 24 patients were having central perforation, 19 patients were having posterior perforation and 17 patients had marginal or attic perforation. The number of smokers in our study was 18 patients out of 90 patients. The age of the patients in our study ranged from 7 years to 46 years.

## **Results**

The present study has been carried out from January 2016 to November 2019. The study comprised of 90 patients suffering from COM with or without cholesteatoma, of the age ranging between 7-46 years and of both the sexes.

In our study, out of 90 patients, 68 patients had tympanic membrane perforation and 22 retraction pocket. Out of 68 patients, 21 had small size, 35 medium

size and 12 patients had large size perforations. Middle ear pathological conditions such as tympanosclerosis, cholesteatoma, granulation tissue and mucosal polyps were also evaluated as prognostic factors.

The results in tympanomastoidectomy with tympanoplasty depend on variety of factors related to both the pathologic condition and the surgical technique. In our study the purpose was to evaluate whether these variables involved in the surgery for COM can predict the anatomical and functional outcome postoperatively. Surgical technique was not taken into account in our study, because the technique used was same throughout the period of study.

### **Tympanic Membrane Graft Uptake**

Tympanic membrane graft uptake in tympanomastoidectomy with tympanoplasty was evaluated at 3 months post operatively. On otoscopic examination successful uptake of graft was taken only in those patients in whom no remnant of perforation was present in any of the quadrant of tympanic membrane.

### **Audiological Gain**

Pure tone audiometry following tympanomastoid surgery was done at 3 and 6 months and audiological improvement (taken as closure of air bone conduction gap) was measured in all patients undergoing the surgery for chronic otitis media. AB gap (air – bone conduction gap) per case was calculated as mean of AB gap at four frequencies (500Hz, 1000Hz, 2000Hz & 4000 Hz) pre operatively and post operatively. Audiological gain was calculated for each patient by subtracting the post op AB gap from the pre op AB gap. The mean was calculated for each variable by dividing the sum of audiological gain in that group by the total number of cases in the same group.

### **Pure Tone Audiometry Result at 3 months:**

In our study of 90 patients, pure tone audiometry was done 3 months postoperatively and audiological gain was evaluated. The tympanic membrane perforation size did not significantly affected the anatomical outcome i.e. graft uptake as well as functional outcome i.e. mean audiological gain at 3 and 6 months postoperatively. The technical factors, mastoidectomy technique (CWU or CWD) and attempt (primary or revision) of the

mastoidectomy, both significantly affected the graft uptake and mean audiological gain.

## Discussion

The principle of management of chronic otitis media is removal of diseased mucosa from the middle ear cleft and an attempt at restoration of hearing. The present study was conducted to assess the prognostic value of the various pathological and the technical factors associated with the COM on the outcome of the surgery. The staging of the surgical procedure according the pathological condition of the middle ear will improve the outcome of the surgery and the compliance of the patients. Middle ear risk index [MERI] is a numerical grading system to stratify the severity of the disease in the patients suffering from the COM. MERI can be used to decide the staging of the surgical procedure according to the severity of the disease.

MERI score was calculated for each patient. Mild, moderate and severe MERI groups were compared for outcome of surgery. MERI was found to be a predictor of outcome in the ear surgeries. The factors analyzed in the present study include perforation size, presence of tympanosclerosis, cholesteatoma, granulation tissue, mucosal polyp, ossicular necrosis, Eustachian tube patency, mastoidectomy technique and primary or revision surgery in COM patients.

### Tympanic Membrane Graft Uptake

Tympanic membrane perforation size was evaluated as determinant of graft uptake. Although lower success rates were observed for patients with larger tympanic membrane perforations, statistical analysis demonstrated no significant difference in surgical success rates between the various perforation size categories ( $p=0.35$ ). Our premise is on the basis that underlay technique of tympanoplasty with adequate graft size covers the membrane defect whether large or small. This result is similar to those of Wasson JD, et al.<sup>[10]</sup>, Pignataro L, et al.<sup>[11]</sup>, Yung MW, et al.<sup>[13]</sup>, Baloch MA, et al.<sup>[14]</sup> and Vartiainen E, et al.<sup>[15]</sup> who have not given any plausible explanation for the conclusion. In our study cholesteatoma was present in 37 patients. The success of graft uptake following tympanomastoidectomy with tympanoplasty was 56.7% in patients with cholesteatoma and 84.9% in patients without cholesteatoma, the difference was

statistically significant ( $p=0.003$ ). Thus, on the basis of this study, cholesteatoma is predictive of result of tympanomastoidectomy with tympanoplasty.

Ossicular necrosis also plays an important role in graft uptake in tympanomastoid reparative surgery. In our study, 51 patients had incus necrosis. The difference in graft uptake between group of patients with necrosed and intact incus was statistically significant ( $p=0.009$ ). In our study 36 patients had malleus necrosis. The difference in graft uptake between group of patients with necrosed and intact malleus was statistically significant ( $p=0.002$ ). In our study 18 patients had stapes necrosis. The difference in graft uptake between group of patients with necrosed and intact stapes was statistically significant ( $p=0.012$ ).

In our study of 90 patients, 78 patients underwent tympanomastoid surgery for the first time, whereas 12 patients underwent revision surgery. The success of graft uptake following primary surgery was 78.2% and in revision surgery it was 41.6%, the difference was statistically significant ( $p=0.008$ ). The result was not in concurrence with the study of Lesinskas E, et al.<sup>[16]</sup>, who reported no statistically significant difference in graft uptake in primary and revision tympanoplasty.

In our study the cholesteatoma, granulation tissue, ossicular necrosis and revision surgery affected the graft uptake, this was due to deep seated destructive process with persistent inflammation in these patients. Our result for graft uptake was poor in the group of the patients having granulating otitis media as given by Albu S, et al.<sup>[7]</sup> for the audiological gain than in the group of patients with simple otitis media. In our study tympanosclerotic plaque was present in 18 patients. The success of graft uptake following tympanomastoidectomy with tympanoplasty was 61.1% in patients with tympanosclerotic plaque and 76.3% in patients without tympanosclerotic plaque. There was no significant difference in graft uptake in both groups ( $p=0.190$ ). Thus, on the basis of this study, tympanosclerotic plaque was not predictive or determinant of successful tympanomastoidectomy with tympanoplasty. Since the tympanosclerotic plaque was removed during tympanoplasty so graft uptake was not affected as the size of perforation was not an influencing factor. This result was in concurrence with that of Wieling EW, et al.<sup>[17]</sup> and Prasad PL, et al.<sup>[18]</sup>.

In our study mucosal polyp was present in 13 patients. The success of graft uptake following tympanomastoidectomy with tympanoplasty was 46.2% in patients with mucosal polyp and 77.9% in patients without mucosal polyp, the difference was statistically significant ( $p=0.017$ ). This may be because of deep seated destructive process with persistent inflammation as in cholesteatoma and granulation tissue patients.

In our study of 90 patients, Eustachian tube was patent in 48 patients and blocked in 42 patients. The success of graft uptake following tympanomastoidectomy with tympanoplasty was 87.5% in patients with patent and 57.1% in patients with blocked Eustachian tube, the difference was statistically significant ( $p=0.006$ ). This suggested that a better ventilated tympanum with patent Eustachian tube was a favourable factor for graft uptake. Our result was in accordance with that of Holmquist [12], Miller and bilodeau [19], Kumazawa, et al. [20] and Tos M [21].

### Middle Ear Risk Index

Statistically significant prognostic difference was found among the patients with mild, moderate and severe MERI on the mean audiological gain at 3 months after surgery. On applying the one way ANOVA the p-value was ( $P=0.01$ ). This observation was in concurrence with the finding of Gulati A, et al. [26] and not in concurrence with findings of Khalid A, et al. [27]. Further post hoc Tukey's Honest Significant Difference test was applied to find the difference between mild, moderate and severe MERI groups. It was found that there was statistically significant difference between mild and severe MERI patients with p-value of ( $P=0.01$ ). Thus a severe MERI as compared to mild MERI can be effectively used a bad prognostic indicator.

In our study the p-value for mean audiological gain in the group of the patients with mild, moderate and severe MERI at 6 months after surgery on applying the one way ANOVA was ( $P=0.02$ ), the difference being statistically significant. This observation was in concurrence with the finding of Gulati A, et al. [26] and not in concurrence with findings of Khalid A, et al. [27]. Post hoc Tukey's Honest Significant Difference test was applied to find the difference between mild, moderate and severe MERI groups. Statistically significant difference was found between mild and severe MERI patients with

p-value of ( $P=0.04$ ).

### Conclusion

The management of chronic otitis media is a surgical endeavour with the primary aim of eradication of disease and making the ear dry and safe and second objective is to restore hearing to serviceable levels by means of tympanoplasty. A better knowledge of the predictive roles of various factors may be useful in the surgeon's judgment of the operative procedure. The second outcome, audiological gain is not significantly affected by the size of tympanic membrane perforation, whereas it is significantly affected by the presence or absence of tympanosclerotic plaque, cholesteatoma, granulation tissue, mucosal polyp, ossicular necrosis, patency of Eustachian tube, mastoidectomy technique (canal wall up or canal wall down) and attempt of surgery (primary or revision). The middle ear risk index of a COM patient is also helpful in predicting the outcome of surgery, MERI calculated for each patient pre-operatively can help us to predict the outcome of surgery for COM. Thus the surgical procedures can be optimised to give the maximum benefit to the patients and also the financial burden of the surgery can be reduced improving the patient compliance in the developing countries.

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