

ORIGINAL RESEARCH

To assess the predictive value of Middle Ear Risk Index Scores in determining hearing threshold following Tympanoplasty in patients diagnosed with Chronic Suppurative Otitis Media

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ABSTRACT

Aim: To assess the predictive value of Middle Ear Risk Index Scores in determining hearing threshold following Tympanoplasty in patients diagnosed with Chronic Suppurative Otitis Media. **Materials and methods:** This research is an observational cohort design that focuses on 50 patients with chronic suppurative otitis media (CSOM) who were receiving tympanoplasty therapy at the Department of Otolaryngology. Following a thorough medical history and standard examination of the ear, nose, and throat, a pure tone audiometry test was conducted before to the surgery to assess the individual's hearing threshold. The MERI Scores were calculated by adding all the scores and then classified into three categories: mild risk (Score 0-3), moderate risk (Score 4-6), and severe risk (Score >7). Approximately 12 weeks after the surgical procedure, a repeat pure tone audiometry was conducted to assess the hearing threshold after the surgery. **Results:** The MERI scores categorized the patients as follows: 32% had mild risk (scores between 0 and 3), 48% had moderate risk (scores between 4 and 6), and 20% had severe risk (scores above 7). For hearing thresholds, patients with mild MERI scores had a preoperative mean hearing threshold of approximately 46.13 dB, which improved to about 31.63 dB postoperatively, showing a mean change of 14.50 dB. This improvement was statistically significant with a p-value of less than 0.001. Patients with moderate MERI scores had a preoperative mean hearing threshold of around 51.05 dB, which improved to 38.09 dB postoperatively, resulting in a mean change of 12.96 dB. This improvement was also statistically significant with a p-value of less than 0.001. For those with severe MERI scores, the preoperative mean hearing threshold was approximately 56.78 dB, improving to about 45.67 dB postoperatively, with a mean change of 11.11 dB. This change was significant as well, with a p-value of less than 0.001. **Conclusion:** Our findings indicate that patients with lower MERI scores, indicating mild risk, showed more significant improvements in hearing thresholds after undergoing tympanoplasty, in comparison to patients with higher MERI scores, indicating moderate and severe risk. The significance of the MERI score in predicting surgical outcomes and informing clinical decision-making for patients with CSOM is emphasized by this.

Keywords: Middle Ear Risk Index, Scores, Hearing threshold, Tympanoplasty, Chronic Suppurative Otitis Media

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INTRODUCTION

Chronic otitis media, formerly referred to as chronic suppurative otitis media (CSOM), is a persistent infection of the middle ear and mastoid cavity that often leads to the formation of a hole in the eardrum. This disorder has the potential to be severe and often leads to significant damage and permanent consequences, including life-threatening issues inside the skull. These difficulties may have a negative

impact on the patient's psychological and social well-being, as well as on their family. The limited representation of individuals with hearing impairment in management, technical, and professional roles may be attributed to the constraints it imposes on physical movement, diminished opportunities for social engagement, and significant financial consequences. In contemporary culture, chronic otitis media and the associated auditory impairment are significant issues.

Therefore, it is necessary to exert efforts in assisting persons who are impacted by these conditions. Due to limited knowledge and access to specialist healthcare, it presents a significant health risk in underdeveloped countries such as India.¹ One of the most difficult components of surgery involving the ear is still the ability to consistently achieve satisfactory hearing outcomes when dealing with chronic otitis media. Patients often undergo medical treatments to address the condition due to its elevated prevalence. This highlights the importance of assessing the severity of an illness and predicting the outcomes of surgical treatment.²

Chronic otitis media leads to a kind of hearing loss known as conductive hearing loss. This type of hearing loss is normally moderate, ranging from 10 to 20 decibels (dB). However, in some situations, erosion of the ossicular chain may occur, resulting in a more severe hearing loss of 50 to 70 dB. This level of hearing loss is generally regarded to be a significant impairment.³

While medicinal therapy may provide temporary alleviation, surgery is the ultimate solution. Tympanoplasty is a surgical treatment that aims to repair the middle ear's system responsible for conveying sound. This therapy is intended to avoid reinfection and restore the capacity to hear. This surgical approach, often performed in conjunction with the repair of a perforated tympanic membrane, may or may not include the rebuilding of ossicles.⁴ Several investigations have shown that the success of tympanoplasty is influenced by several variables, including the size and position of the hole, the condition of the ossicles, the specific surgical method used, and the severity of otorrhea.^{5,6} Predicting the result of a surgical treatment before it takes place will be essential in explaining and persuading the patient to undergo surgery, particularly in poor countries where the expense of surgery is a significant constraint. In 1965, the American Academy of Ophthalmology and Otolaryngology Subcommittee on Conservation of Hearing created a standard classification for surgery for chronic middle ear infection. They defined tympanoplasty as a procedure to remove disease from the middle ear and restore the hearing mechanism.⁷

Kartush implemented the use of the MERI (Middle Ear Risk Index) to enhance the accuracy of tympanoplasty prognosis. Becvarovski and Kartush established and revised the middle ear risk score in 2001 to forecast the outcome of tympanoplasty. This index produces a quantitative measure of the intensity of the middle ear ailment. MERI combines the established preoperative and intraoperative risk factors for the prognosis of tympanoplasty into a quantifiable number. To enhance the understanding of these basic principles and categorize patients into additional prognostic groups, Kartush made adjustments to the Austin classification and established the middle ear risk index (MERI). A risk

value was given to each parameter that was tracked, including otorrhea, eardrum perforation, cholesteatoma, ossicular status, middle ear granulations or effusions, previous surgery, and smoking. Additionally, it enables meaningful comparisons in studies by clearly defining crucial data and categorizing instances based on several prognostic criteria. Multiple publications have been published that examine predictive variables in tympanomastoid surgery and its influence on hearing outcomes.⁸ Black proposed the SPITE system, which stands for Surgical, Prosthetic, Infection, Tissues, and Eustachian tube function, as a set of prognostic factors for tympanoplasty.⁹

AIMS AND OBJECTIVES

To assess the predictive value of Middle Ear Risk Index Scores in determining hearing threshold following Tympanoplasty in patients diagnosed with Chronic Suppurative Otitis Media in present study.

MATERIALS AND METHODS

This research is an observational cohort design that focuses on 50 patients with chronic suppurative otitis media (CSOM) who were receiving tympanoplasty therapy admitted to the ENT emergency/OPD, Department of Otorhinolaryngology (ENT), Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India. Written consent from parents was obtained in order to take part in the study. The study was conducted from January 01, 2022 to October 30, 2022. The Institutional Ethics Committee gave the study its approval. Data such as name, age, etc. was recorded. Each patient provided their informed permission. The research comprised patients who were diagnosed with CSOM and expressed their willingness to participate.

The study excluded individuals with congenital deafness, sensorineural deafness caused by conditions such as diabetes mellitus, dyslipidemia, and hypertension, a history of using ototoxic drugs, a history of exposure to noise or acoustic trauma, and those who could not attend follow-up appointments for the next three months after the operation.

Tympanoplasty is a surgical treatment used to treat illnesses in the middle ear and restore the hearing mechanism. It involves the reconstruction of the tympanic membrane, with or without the use of grafts. Tympanoplasty is classed into five types, ranging from type I to type V. In this research, we classified hearing changes as any alterations in hearing threshold of at least five decibels relative to the preoperative value, which were measured using pure tone audiometry. The MERI score is a metric used to forecast the average success rates for the middle ear reconstruction process. The evaluated factors included the existence of otorrhea, the nature of the tympanic membrane perforation, the presence of cholesteatoma, the condition of the ossicular chains, the presence of granulation in the middle ear, the history of previous

surgery, and the individual's smoking status. An evaluation was conducted before and during the surgical procedure.

Following a thorough medical history and standard examination of the ear, nose, and throat, a pure tone audiometry test was conducted before to the surgery to assess the individual's hearing threshold. The MERI Scores were calculated by adding all the scores and then classified into three categories: mild risk (Score 0-3), moderate risk (Score 4-6), and severe risk (Score >7). Approximately 12 weeks after the surgical procedure, a repeat pure tone audiometry was conducted to assess the hearing threshold after the surgery.

STATISTICAL ANALYSIS

The collected data was analysed using Microsoft Excel 16 and SPSS version 21. The study's statistical analysis used the Chi square test, with a p-value of

0.05 being deemed statistically significant.

RESULTS

The study included 50 patients who underwent tympanoplasty and met the inclusion criteria. These patients were categorized into three risk groups based on their Middle Ear Risk Index (MERI) scores: mild, moderate, and severe.

The patients' ages ranged widely, with the majority falling between 30 - 40 years old. Specifically, 8% were under 20, 16% were between 20 -30, 44% were between 30 -40, 22% were between 40 -50, and 10% were over 50 years old. The average age of the participants was approximately 35.23 years. In terms of gender distribution, 60% were male and 40% were female. The average duration of chronic suppurative otitis media (CSOM) among the participants was about 7.34 years. Regarding smoking status, 38% were smokers and 62% were non-smokers [Table 1].

Table 1: Demographic parameter of Study Participants

Parameter	Number =50	Percentage
Age		
Below 20	4	8
20-30	8	16
30-40	22	44
40-50	11	22
Above 50	5	10
Mean Age (years)	35.23 ± 5.37	
Gender		
Male	30	60
Female	20	40
Duration of CSOM	7.34 ± 1.67 years	
Smoking Status		
Smokers:	19	38
Non-Smokers	31	62

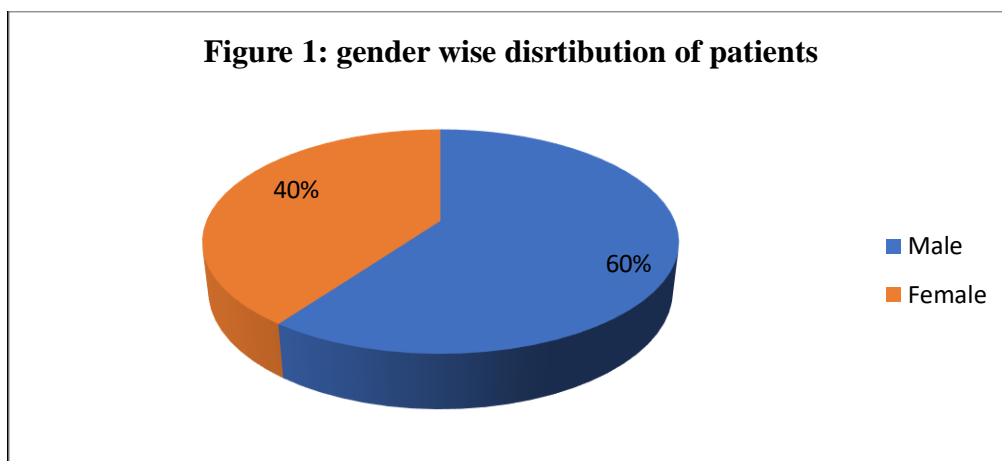


Table 2: Distribution of MERI Scores Among Patients

MERI Risk Category	Score Range	Number =50	Percentage
Mild	0-3	16	32
Moderate	4-6	24	48
Severe	>7	10	20

The MERI scores categorized the patients as follows: 32% had mild risk (scores between 0 and 3), 48% had moderate risk (scores between 4 and 6), and 20% had severe risk (scores above 7) [Table 2].

Table 3: Preoperative and Postoperative Hearing Thresholds (in dB)

MERI Risk Category	Preoperative Mean (\pm SD)	Postoperative Mean (\pm SD)	Mean Change (\pm SD)	Significant Improvement (p-value)
Mild	46.13 \pm 3.56	31.63 \pm 3.87	14.50 \pm 3.98	< 0.001
Moderate	51.05 \pm 4.75	38.09 \pm 4.87	12.96 \pm 3.44	< 0.001
Severe	56.78 \pm 3.87	45.67 \pm 4.77	11.11 \pm 4.21	< 0.001

For hearing thresholds, patients with mild MERI scores had a preoperative mean hearing threshold of approximately 46.13 dB, which improved to about 31.63 dB postoperatively, showing a mean change of 14.50 dB. This improvement was statistically significant with a p-value of less than 0.001. Patients with moderate MERI scores had a preoperative mean hearing threshold of around 51.05 dB, which improved to 38.09 dB postoperatively, resulting in a

mean change of 12.96 dB. This improvement was also statistically significant with a p-value of less than 0.001. For those with severe MERI scores, the preoperative mean hearing threshold was approximately 56.78 dB, improving to about 45.67 dB postoperatively, with a mean change of 11.11 dB. This change was significant as well, with a p-value of less than 0.001 [Table 3].

Table 4: Detailed MERI Score Components Distribution

MERI Component	Mild (n=15)	Moderate (n=25)	Severe (n=10)
Otorrhea	5	15	10
Tympanic Membrane Perforation	10	20	10
Cholesteatoma Presence	2	10	8
Ossicular Chain Status	15	15	10
Middle Ear Granulation	1	10	10
Prior Surgery	3	10	8
Smoking Status	3	9	7

Among patients with mild risk, 5 had otorrhea, 10 had tympanic membrane perforation, 2 had cholesteatoma, all 15 had intact ossicular chains, 1 had middle ear granulation, 3 had a history of prior surgery, and 3 were smokers. In the moderate risk group, 15 patients had otorrhea, 20 had tympanic membrane perforation, 10 had cholesteatoma, 15 had intact ossicular chains, 10 had middle ear granulation, 10 had a history of prior surgery, and 9 were smokers. For the severe risk group, 10 patients had otorrhea, 10 had tympanic membrane perforation, 8 had cholesteatoma, all 10 had intact ossicular chains, 10 had middle ear granulation, 8 had a history of prior surgery, and 7 were smokers [Table 4].

DISCUSSION

COM is a very prevalent illness globally, especially in impoverished nations. Based on the 2004 WHO data, the Indian population has a 7.8% prevalence of COM. It is linked to the lack of education, inadequate personal cleanliness, and inferior economic standing, and is more prevalent among those living in rural areas. Several variables impact the result of surgery for COM, and MERI quantifies these variables into a numerical number. The purpose of this research was to evaluate the predictive significance of the MERI score in relation to the surgical outcomes of COM.¹⁰

The patients' ages exhibited a broad variation, with the majority falling within the 30 to 40 year old bracket. More precisely, 8% of the individuals were younger than 20, 16% were aged between 20-30, 44%

were aged between 30 -40, 22% were aged between 40 - 50, and 10% were older than 50 years. The participants had an average age of roughly 35.23 years. The age distribution in our study aligns with the findings of Bhankhodia et al. and Gandhi et al., who also observed that the majority of patients with chronic suppurative otitis media (CSOM) receiving tympanoplasty were between the ages of 30 and 40.^{11,12}

The gender distribution of 60% male and 40% female aligns with the results of Radhakrishnan et al.¹³ who observed a greater occurrence of CSOM in males. The MERI scores classified patients into risk groups as follows: 32% mild, 48% moderate, and 20% severe. The observed distribution of patients in this study is consistent with the results of earlier research that used MERI to classify individuals with CSOM. This indicates a comparable risk profile within the population under investigation.

The improvements in hearing thresholds post-tympanoplasty were statistically significant across all MERI risk categories: Mild Risk Group: The mean hearing threshold improved from 46.13 dB preoperatively to 31.63 dB postoperatively, with a mean change of 14.50 dB (p < 0.001). This substantial improvement supports findings from Maddernet al.¹⁴ where patients with lower risk profiles showed better postoperative outcomes. Moderate Risk Group: The mean hearing threshold improved from 51.05 dB preoperatively to 38.09 dB postoperatively, with a mean change of 12.96 dB (p < 0.001). This is

comparable to studies by Mohammadi et al.¹⁵ and Hossain et al.¹⁶, which also reported significant improvements in moderate risk groups. Severe Risk Group: The mean hearing threshold improved from 56.78 dB preoperatively to 45.67 dB postoperatively, with a mean change of 11.11 dB ($p < 0.001$). These results are consistent with Handler and Miller's findings, where even patients with severe MERI scores showed significant postoperative hearing improvement.¹⁷

In the mild risk group, fewer patients had otorrhea (5), cholesteatoma (2), and middle ear granulation (1), and all had intact ossicular chains. This pattern of fewer complications in the mild risk group is consistent with the study by Verma et al., who also noted that patients with lower MERI scores had fewer adverse middle ear conditions.¹⁸

The moderate risk group had a higher incidence of otorrhea (15), tympanic membrane perforation (20), cholesteatoma (10), and middle ear granulation (10), with a mix of intact and non-intact ossicular chains. This distribution aligns with findings from studies like Sasindran et al., highlighting that moderate risk patients often present with a greater number of middle ear issues.¹⁹

For the severe risk group, the presence of otorrhea (10), cholesteatoma (8), and middle ear granulation (10) was more common, and all patients had intact ossicular chains. This group's profile is similar to that described by Beattie et al.²⁰, where severe risk patients frequently exhibited multiple middle ear pathologies.

Limitations of study: The small sample size and short duration of the study.

CONCLUSION

Our findings indicate that patients with lower MERI scores, indicating mild risk, showed more significant improvements in hearing thresholds after undergoing tympanoplasty, in comparison to patients with higher MERI scores, indicating moderate and severe risk. The significance of the MERI score in predicting surgical outcomes and informing clinical decision-making for patients with CSOM is emphasized by this.

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