Middle Ear Risk Index and results of pediatric tympanoplasty - adequate predictor?

Original Article

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Abstract

Aim: To assess the usefulness of the Middle Ear Risk Index (MERI) in adequately predicting the success of tympanoplasty in the pediatric population.
Methods: Retrospective study of children (age under 18 years old) who underwent tympanoplasty between 2014 and 2021. Demographic data, contralateral ear status, surgical technique, type of graft, pre and postoperative audiometric data and MERI score were collected.
Results: Forty-seven children were evaluated (total of 58 ears), with an average age of 13±2.71 years. Cases with MERI lower than three had an odd ratio value of 0.35, demonstrating that this score is a protective factor for favorable postoperative results. In cases compatible with severe disease (MERI > 7) there was a chance about 17 times higher of having an unfavorable outcome in the postoperative period. Both these results were statistically significant ($p<0.05$).
Conclusion: This study concludes that the MERI can be a useful tool in the preoperative evaluation in order to assess the probability of success of pediatric tympanoplasty.
Keywords: Tympanoplasty; Pediatrics; Middle Ear Risk Index; tympanic membrane.

Introduction

Chronic otitis media is an inflammatory disease of the middle ear and mastoid that is typically associated with perforation of the tympanic membrane and is a frequent indication for tympanoplasty.[1,2] Considering the high prevalence of hearing diseases in childhood, tympanoplasty in the context of chronic infection and perforation has become a common surgical procedure in the pediatric population.[2] However, the results obtained in this age group vary widely, with e success rates reportedly ranging between 35% and 94%.[3-6]
The current evidence indicates that the preoperative status of the middle ear is a determinant of the success of tympanoplasty.[7,8]

Multiple classification scales based on risk factors have been described for the evaluation of middle ear disease.[9,10] The Middle Ear Risk Index (MERI) is one of the most recognized and used scales for the stratification of middle ear disease severity.[8-10] MERI scores are calculated by attributing specific values to different risk factors and adding these up to obtain the final result. The risk factors included in the calculation are as follows: otorrhea, ossicular chain status, tympanic perforation, middle ear effusion, cholesteatoma, and history of previous surgery. The scores of the risk categories (MERI scores) range between 0 and 12, with the following correspondence: 0, normal; 1–3, mild disease; 4–6, moderate disease, and 7–12, severe disease.[10]

Although multiple risk factors have been examined to predict the success of tympanoplasty in childhood, investigating the role of MERI as a reliable scale for the prediction of tympanoplasty outcomes is important because of its ease of use and reproducibility. The objective of this study was to determine the usefulness of MERI as a predictor of successful tympanoplasty in children.

Materials and Methods

This retrospective study included all children with a tympanic perforation (aged less than 18 years) who underwent tympanoplasty (primary or revision surgery) between 2014 and 2021 at our hospital. All surgeries performed within this period were included, regardless of the surgeon. The excluded patients were those who had a cholesteatoma, those who had previously undergone mastoidectomy or surgery to reconstruct the ossicular chain, those who required ossiculoplasty or mastoidectomy during the same operation, and those with a postsurgical follow-up period shorter than one year. Demographic and clinical data regarding the status of the contralateral ear, surgical technique, type of graft, pre- and postoperative audiometry results, and MERI scores were collected (Table 1). All patients were assessed by pure-tone audiometry for both the air- and bone-conduction pathways, pre- and postoperatively, for a period of up to six months before and after the procedure. The pure-tone thresholds were presented as pure-tone threshold averages (PTA) in decibels (dB) at frequencies of 500,1000, 2000, and 4000 Hz.[12] The air-bone gap (ABG) was calculated by the difference between the air and bone PTA. The surgical results were evaluated in terms of the anatomical and functional outcomes. Anatomical success was defined as integrity of the tympanic membrane at 12

Table 1
Middle Ear Risk Index
(adapted from Kartush JM *et al*., 2002)

Risk factor	Value
Otorrhea (Bellucci)	
Dry	0
Occasionally wet	1
Persistently wet	2
Wet, palatine cleft	3
Perforation	
Absent	0
Present	1
Cholesteatoma	
Absent	0
Present	1
Status of the ossicular chain (Austin/Kartush)[a]	
M + I + S+	0
M + S+	1
M + S-	2
M-S+	3
M-S -	4
Fixation of the head of the malleus	2
Fixation of the stirrup	3
Middle ear: Effusion or granulation	
No	0
Yes	2
Previous surgery	
No	0
Primary	1
Revision	2
Smoker	
No	0
Yes	2

a - M – Malleus, I – Incus, S – Stirrup; (+) present; (-) absent

months after surgery. Functional success was defined a PTA lower than 20 dB in pure-tone audiometry of the air-conduction pathway performed between three and six months after the surgery. Both anatomical and functional successes were considered the primary outcomes of the study. A comparison between patients with successful anatomical and functional outcomes and those with unsuccessful outcomes was performed. The results of the descriptive statistical analysis are expressed as frequencies and percentages for categorical variables and as means and standard deviations for continuous variables. The categorical variables were compared using Fisher's test or chi-squared test. The odds ratio (OR) was calculated with a confidence interval of 95%. Statistical significance was set at $p \leq 0.05$. The statistical analysis was performed using the IBM SPSS Statistics for Mac software, version 21.0.

Results

Forty-seven children were included in the study; 28 boys and 19 girls with a mean age of 13 ± 2.71 years (8–17 years) at the time of the surgery. The surgery was performed in a total of 58 ears, with eight children undergoing revision surgery and three children undergoing bilateral tympanoplasty.

With regard to the surgical results, 44 (75.9%) ears exhibited an intact tympanic membrane at 12 months after the intervention. The median follow-up period was 29.5 ± 24 months (12–78 months). Relapse of perforation occurred in fourteen ears and the mean time to detection was 5.5 ± 3.2 months. With regard to the functional outcomes, there was a reduction in the mean ABG in 87.8% cases to values lower than 10 dB. The preoperative PTA of the air-conduction pathway (PTA-ACP) was 19.6 ± 8.5 dB, while postoperative audiometry showed a PTA-ACP of 9.9 ± 7.5 dB, indicating that there was a mean gain of 10 dB after tympanoplasty. Tympanic membrane perforation was associated with chronic otitis media in 65.5% of the patients and otoscopy showed a normal contralateral ear in 77.5% of the patients. The underlay tympanoplasty technique was used in the majority of the cases (96.6%) and the temporal fascia was the most frequently used graft tissue (70.7%). There were no statistically significant differences in the study variables between the two groups (successful cases versus surgical failures). The analyzed variables are described in Tables 2 and 3.

Thirty-six ears had a MERI score lower than 3 (mild disease), and its association with successful postoperative results was statistically significant. Patients with a MERI score higher than 7 (severe disease) were significantly associated with unsatisfactory postoperative results, i.e., unsuccessful anatomical or functional results. Moderate MERI scores did not demonstrate a significant association with the postoperative results. In addition, patients with MERI scores lower than 3 had an OR of 0.35 (p=0.042), suggesting that

Table 2
Descriptive analysis of the study variables

Variable	n (%)
Sex	
Female	19 (32,7)
Male	28 (48,3)
Etiology of tympanic perforation	
Chronic otitis media	38 (65,5)
Removal of ventilation tube	18 (31,1)
Trauma	2 (3,4)
Contralateral ear	
Normal	45 (77,5)
Otitis media with effusion	2 (3,5)
Tympanic membrane retraction	3 (5,2)
Tympanic perforation	8 (13,8)
Tympanoplasty technique	
Underlay	56 (96,6)
Overlay	2 (3,4)
Type of graft	
Temporal fascia	41 (70,7)
Cartilage + Perichondrium	11 (18,9)
Fascia + Cartilage	6 (10,4)

Table 3
Comparative analysis of the study variables

Variable	Outcome – n (%)		
	Success	Failure	p value
Sex			
Female	14 (73,7)	5 (26,3)	0,457
Male	19 (67,9)	9 (32,1)	
Etiology of tympanic perforation			
Chronic otitis media	29 (76,3)	9 (23,7)	0,331
Removal of ventilation tube	13 (72,2)	5 (27,8)	
Trauma	2 (100)	0 (0)	
Contralateral ear			
Normal	35 (77,8)	10 (22,2)	0,248
Otitis media with effusion	2 (100)	0 (0)	
Tympanic membrane retraction	2 (66,7)	1 (33,3)	
Tympanic perforation	5 (62,5)	3 (37,5)	
Tympanoplasty technique			
Underlay	43 (76,8)	13 (23,2)	1,000
Overlay	1 (50.0)	1 (50.0)	
Type of graft			
Temporal fascia	32 (78,1)	9 (21,9)	0,625
Cartilage + Perichondrium	8 (72,7)	3 (27,3)	
Fascia + Cartilage	4 (66,7)	2 (33,3)	

p – value indicates statistical significance

Table 4
Association between Middle Ear Risk Index (MERI) scores and outcomes of tympanoplasty

	Postoperative status of the Tympanic Membrane				
MERI score	Intact (n)	Perforated (n)	OR	95% CI	p value
Mild (1–3)	30	6	0.35	0.10 ; 1,20	0,042
Moderate (4–6)	13	4	0.95	0,25 ; 3,60	0,944
Severe (7–12)	1	4	17,20	1,73 ; 23,52	0,002

MERI – Middle Ear Risk Index; OR – Odds Ratio; CI – Confidence Interval; p value indicates statistical significance

it is a protective factor against surgical failure. In severe cases (MERI > 7), the patients were approximately 17 times more likely to have an unfavorable postoperative outcome (p=0.002). The results are shown in Table 4.

Discussion

Tympanoplasty is a commonly performed procedure in children. Previously published studies have demonstrated its benefits in this age group and investigated the most important determinants of surgical success with the aim of selecting the best candidates for tympanoplasty.[4,5] In the present study, the rates of surgical anatomical and functional success were 75.9% and 87.8%, respectively, with a minimum follow up period of 12 months, demonstrating that tympanoplasty is a safe and highly effective procedure in childhood. Our results are similar to those of other studies

in which the same definitions of anatomical and functional success were used. Gonçalves et al. obtained anatomical and functional success rates of 81.3% and 87.5%, respectively, while Çayir et al. reported a functional success rate between 85.7% and 90.4%, depending on the type of graft used.[5,14] Similarly, Baklaci et al. showed an anatomical success rate of 86.3% and functional success rate of 74.5%.[4]

Multiple factors have been shown to influence the surgical success of pediatric tympanoplasty, including the status of the contralateral ear, the type of tissue used as graft, and the surgical technique. In the present study, there were no statistically significant differences in these factors between the two groups (surgical success versus failure), which shows that in isolation, they may not play a major role in determining the outcomes, a finding that has also been confirmed by previous studies.[11,14,15]

The assessment of middle ear status is a crucial factor for surgical success. The MERI has been shown to be useful for the prediction of surgical outcomes, and some studies have shown a positive correlation between the MERI scores and recurrence of postoperative tympanic perforation.[7,8,16] In the present study, we demonstrated that a MERI score higher than 7 was significantly correlated with the likelihood of an unfavorable postoperative outcome, whereas scores lower than 3 (mild disease) were found to be protective against surgical failure. These findings are in line with those reported in the literature, emphasizing the reproducibility of the MERI in children.[1,8]

The main limitations of this study are its retrospective nature, the small sample size, and limited availability of clinical information. Other potential limitations are as follows: some of the analyzed variables were subjective; the surgical procedures were performed by different surgeons; and lack of an evaluation of concomitant sinonasal disease or other confounding factors such as the size of the perforation, Eustachian tube function, and postoperative complications. Lastly, the small number of cases may limit the generalizability of the conclusions of this study. It is thus necessary to conduct more prospective studies, preferably randomized controlled studies with a well-established protocol for clinical data collection, on order to validate the MERI in children.

Conclusion

The present study demonstrates that the MERI is a useful tool during presurgical evaluation for predicting the success of tympanoplasty in children. A MERI score lower than 3, which reflects mild disease, was associated with favorable outcomes whereas a MERI score higher than 7 was correlated with a 17 times higher likelihood of no anatomical or functional improvement after surgery. The MERI is a useful tool in clinical practice because it allows selection of the best candidates, identification of risk factors that may be optimized before the surgical intervention, and giving information to the patient about the probability of surgical success.

Conflict of interest

The authors declare no conflict of interest regarding this article.

Data confidentiality

The authors declare that they followed the protocols in use at their working center regarding the publication of patients' data.

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Availability of scientific data

There are no publicly available datasets related to this study.

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