

ORIGINAL ARTICLE

Use of Middle Ear Risk Index and Eustachian Tube Function as Parameters for Predicting the Outcome of Tympanoplasty

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Abstract :

Otitis media is an important and highly prevalent disease of middle ear and poses serious health problem worldwide in developing countries where large population lacks specialized medical care. It is important to assess the severity of this disease & accordingly predict the result of surgery. In this study of 67 cases of tubotympanic variety of CSOM we have used MERI & ETF as predictors for the outcome of tympanoplasty.

INTRODUCTION

Chronic suppurative otitis media (CSOM) is of two types tubotympanic (mucosal) and atticofacial (squamous). The atticofacial type (squamous type) is due to cholesteatomatous lesions. Tubotympanic type (mucosal) is mainly due to infection from the oropharynx and the nasopharynx and sources like gastro esophageal reflux diseases travels via the Eustachian tube into the middle ear.¹

It is important to assess the severity of disease and predict the outcome of surgical management. Goals of surgical management of chronic otitis media include removal of inflammation and creation of sound conducting mechanism in well aerated, mucosal lined middle ear. Numerous prognostic factors affecting hearing among the patients with chronic otitis media have been discussed in this literature. Ossicular reconstruction is performed to attempt to restore continuity and support conduction capabilities of ossicular chain. Artificial reconstruction materials are alternative but have their own concern regarding audiological outcome and complication rates. There are many variables that may influence hearing results. MERI is one of the most reliable tool to evaluate the result of ossicular reconstruction and compare outcome among different studies.²

A normally functioning eustachian tube is an equally essential physiologic requirement for a healthy middle ear and normal hearing. Three main functions of eustachian tube are ventilation and regulation of middle ear pressure, middle ear clearance of secretions, and protection against nasopharyngeal sound pressure and reflux of nasopharyngeal secretions. A normal aerated middle ear cavity and normal antrum are important for middle ear functions.³ Impedance audiometry (Toynbee's test) is an

essential tool to assess eustachian tube function (ETF) in perforated tympanic membrane and William's test is an essential tool to assess the ETF in intact tympanic membrane.

In this study we have used the middle ear risk index (MERI) developed by Kartush which generates a numeric indicator of the severity of the middle ear disease to stratify patient groups according to the severity of the disease and to evaluate the efficiency of MERI score in predicting the outcome of tympanoplasty.

AIMS AND OBJECTIVES

1. To assess the result of surgical treatment of tubotympanic chronic suppurative otitis media in relation to the MERI.
2. To study the effect of Eustachian tube function on result of tympanoplasty.

MATERIAL AND METHODOLOGY

This is a prospective study to assess the result of surgical treatment of tubotympanic chronic suppurative otitis media and its relation to the MERI & to study the effect of Eustachian tube function on result of tympanoplasty. The procedure to be performed was explained to the patients and their relatives and written informed consent was taken.

All the patients with discharging ear were treated conservatively using antibiotics, antihistaminic, decongestants and topical ear drops to be instilled by displacement method and once a dry ear was achieved the patients underwent tympanoplasty with or without cortical mastoidectomy. Pre-operative assessment of status of ear before surgery (quiescent/inactive), ETF, type of hearing loss (conductive/mixed/SNHL) were done and recorded. Risk categories were derived from the

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MERI scoring chart given below and the severity of the disease was noted.

Detailed history, clinical and otomicroscopic examination were carried out after taking informed written consent of patients. X-ray of both mastoids in Schuller's view in all patients were done.

Pre-operative pure tone audiometry was carried out in 1 week or less before surgery on OPD basis. It was performed in acoustically treated room with advanced digital audiometer, "Elkon eda 3 n 3 multi". Technique followed was Carhart and Jerger's technique, which is commonly used (technique of 5-up and 10-down method). The hearing was tested at frequencies 250Hz - 8000Hz, for each ear separately. The air conduction threshold and bone conduction threshold averages were calculated by taking the averages of 0.5, 1, 2 and 4 KHz frequencies. The air bone gap (ABG) was calculated taking the differences between air conduction and bone conduction threshold. Pre-operative Eustachian tube function was assessed by two ways:

- (a) Instillation of antibiotic ear drop
 - (b) ET functions by impedance audiometry
- **Assessment of eustachian tube function in intact drum (William's test)**
 1. Done in patients with intact ear drum.
 2. Measure middle ear pressure at the start of test (resting pressure), after patient swallows (with nose and mouth closed), and finally after performing valsalva.
 3. Pressure should become negative on swallowing and positive on valsalva.
 4. Normal ambient middle ear pressure is slightly negative.
 5. If middle ear pressure becomes negative on swallowing but does not become positive on valsalva or vice versa partially impaired and does not change at all on these maneuver grossly impaired.⁴
 - **Assessment of eustachian tube function in perforated drum (Toynbee's test)**
 1. Done in patients of perforated ear drum.
 2. The impedance audiometer is programmed to artificially increase or decrease the air pressure at the middle ear and then record the change of air pressure in the middle ear each time when the patient swallows.
 3. The patient is asked to swallow repeatedly and recorded graphically by impedance audiometer.

4. Change of pressure during swallowing is recorded as step ladder type of graph, that is, normal.
5. If some residual pressure persists even after five swallows, the tubal function is considered to be partially impaired and if cannot be neutralized at all by repeated swallowing, then the ETF is considered to be grossly impaired.⁴

After obtaining the pre anesthetic fitness and consent for surgery, tympanoplasty/cortical mastoidectomy with tympanoplasty was performed under general anesthesia in every patient. In all cases ossiculoplasty was performed in one stage using post aural, endaural or endomeatal approach. Temporalis fascia was used as the graft material for tympanic membrane reconstruction with underlay technique.

We have used conchal cartilage, tragal cartilage or thick homologous septal spur cartilage near maxillary crest for reconstruction of ossicular chain after sculpturing them appropriately. Conchal cartilage was harvested with perichondrium preserved on both side. Tragal cartilage was harvested with perichondrium on one side from tragus by putting separate incision on medial surface of tragus. Homologous thick septal cartilage was harvested during septoplasty from near the maxillary crest which was then preserved in 70% ethyl alcohol.

Patients were followed-up postoperatively on 7th day for stitch removal and after 3 weeks, 2, 3 and 6 months for assessment of graft take-up. Post-operative pure tone audiometric thresholds were recorded on 12th week. The functional results were evaluated according to the guidelines of committee on hearing and equilibrium of American Academy of Otolaryngology Head & Neck Surgery (AAOHN) except for 3 KHz which was substituted in all cases with threshold at 4 KHz. Pure Tone Average was calculated as the mean of 0.5, 1, 2, and 4 KHz. Post-operative Mean airbone gap (ABG) was calculated from air Conduction (AC) and bone conduction (BC) thresholds in each patient. Postoperative ABG closure was calculated by taking the difference between the average preoperative ABG and postoperative ABG.

OBSERVATION & DISCUSSION

In present study, 67 patients were included. There were total 23 males & 44 females. 27 patients had bilateral perforation & 40 patients had unilateral perforation, in which 36 patients were operated on left side and 30 patients were operated on right side. In all 67 patients, 59 patients had complain of ear discharge from affected ear, 49 patients had complain of earache, 44 patients had complain of decreased hearing & 4 patients had complain of tinnitus. No patients had complain of giddiness, facial deviation.

Table I Middle Ear Risk Index⁶

Risk factors	Value assigned score
1. Otorrhea(Belluci classification)	
a. Dry	0
b. Occasionally wet	1
c. Persistently wet	2
d. Wet, cleft palate	3
2. Perforation	
None	0
Present	1
3. Cholesteatoma	
None	0
Present	1
4. Ossicular status (Austin classification) ⁵	
a. M +I +S+	0
b. M + S+	1
c. M + S-	2
d. M -S+	3
e. M -S-	4
f. Ossicular head fixation	2
g. Stapes fixation	3
5. Middle ear granulations or effusion	
No	0
Yes	2
6. Previous surgery	
None	0
Staged	1
Revision	2

MERI 0 normal, MERI 1-3 mild disease, MERI 4-6 moderate disease, MERI 7-12 severe disease

Table II Distribution of patients according age groups (in years)

Age group	No of patients
11-20	28(41.79%)
21-30	14(20.89%)
31-40	17(25.37%)
41-50	6(8.95%)
51-60	1(1.5%)
61-70	1(1.5%)

Table III Distribution of Patients according to MERI score, ETF & graft take up

MERI score	No of patients	Normal ETF	Poor ETF	Graft take up
1-3	38(56.71%)	29	9	35(92%)
4-6	27(40.29%)	9	18	24(88%)
7-12	2(2.98%)	1	1	2(100%)

On otoscopic examination, 29 patients had large central perforation, 33 patients had moderate central perforation, 4 patients had small central perforation, 1 patient had two small central perforations.

According to Belluci classification, on basis of perforation, presence of granulations, erosion of ossicles & type of surgery, all patients were given MERI score. According to MERI score, between 1 – 3, there were 38 patients, between 4 – 6, there were 25 patients & between 7- 12, there were 4 patients. In 67 patients, total 40 patients had normal Eustachian tube function(ETF) and 28 patients had poor ETF.

Among 67 patients, in 16 patients mastoid were pneumatized & in rest 51 patients they were sclerosed.

Among 67 patients, total 51 patients underwent cortical mastoidectomy and tympanoplasty and 16 patients underwent only tympanoplasty. In total 67 patients, 24 patients underwent cortical mastoidectomy type III tympanoplasty, 27 patients underwent cortical mastoidectomy type I tympanoplasty & 16 patients underwent only tympanoplasty without cortical mastoidectomy. In tympanoplasty, in 5 patients it was done by endomeatal route, in 2 patients by endaural route and in rest patients by post aural route. In type III tympanoplasty, tragal cartilage was used in 11 patients, conchal cartilage was in 3 patients, nasal septal spur cartilage was used in 9 patients & remodeled incus were used in 2 patients.

Table IV Distribution of patients according to type of surgery

Type I tympanoplasty	Cortical mastoidectomy + type I tympanoplasty	Cortical mastoidectomy + type III tympanoplasty
16	27	24

In all patients post-operative PTA was done after 12 weeks. In 67 patients, pre-operative ABG was 37.97±11.08 dB, post-operative ABG was 24.79±12.89 dB and hearing result was 13.19±11.08 dB. In type I tympanoplasty with cortical mastoidectomy pre-operative ABG was 39.89±9.747 dB & post-operative ABG was 20.3±8.054 dB. Hearing result was 19.62±10.73 dB. In type III tympanoplasty with cortical mastoidectomy, pre-operative ABG was 40.98±9.65 dB and post operative ABG was 35.29. Hearing result was 5.69±10.69 dB. In tympanoplasty patients, preoperative ABG was 30.24±12.14 dB and post operative ABG was 16.64±8.78 dB. Hearing result was 13.59±8.14 dB. In total 67 patients there were post-operative defect in graft in 6 patients in which, 5 patients have poor ETF & 1 patient have normal ETF.

Table V Comparison of hearing results in relation to type of surgery

	Type I tympanoplasty	Cortical mastoidectomy type I tympanoplasty	Cortical mastoidectomy type III tympanoplasty
Pre op ABG(dB)	30.24±12.14	39.89±9.747	40.89±9.65
Post op ABG(dB)	16.64±8.78	20.38±0.054	35.29±12.97
Hearing result(dB)	13.59±8.14	19.62±10.73	5.69±10.69

Patients with MERI score between 0-3, preoperative ABG was 36.49±11.80 dB, post operative ABG was 18.53±8.69 dB & hearing gain was 17.97±10.53 dB. Patients with MERI score between 4-6, preoperative ABG was 40.6±9.75 dB, post operative ABG was 31.78±13.63 dB & hearing gain was 8.82±12.55 dB. Patients with MERI score between 7-12, preoperative ABG was 35.64±11.28 dB, post operative ABG was 40.63±0 dB & hearing gain was -4.99±0 dB.

Table VI Comparison of hearing results in relation to MERI score

MERI score	Pre operative ABG	Post operative ABG	Hearing result
0-3	36.49±11.80	18.53±8.69	17.97±10.53
4-6	40.6±9.75 dB	31.78±13.63	8.82±12.55
7-12	35.64±11.28	40.63±0	-4.99±0

Nishant et al.2 conducted similar study, enrolled 50 patients in study. It was observed that maximum number of ears 36 (72%) fall under MERI 1-3 i.e. mild disease followed by 12(24%) ears with MERI score of 4-6 i.e. moderate disease and then by 2 (4%) ears with MERI score of 7-12 i.e. Severe disease. In this study, out of 50 patients who underwent tympanoplasty, graft was accepted in 40(80%) patients & rejected in 10(20%) patients, in which 6 patients had Eustachian tube dysfunction & 2 patients were having MERI score of 7-12 i.e. severe disease so there was 100% graft rejection in patients with MERI score 7-12. In our study, total graft was rejected in 6 patients in which 5 patients had Eustachian tube dysfunction but in our study there was 100% graft acceptance in patients with MERI score between 7-12.

Sharma A et al.7 conducted study for correlation of MERI & hearing outcome after tympanoplasty. In this study, 50 patients were enrolled. In this study, most of the patients had mild MERI (64%), followed by severe MERI (20%) and then moderate MERI (16%). The mean preoperative PTA average was 44.34 dB (SD 8.01 dB) for patient with

mild MERI, 44.75 dB (SD 5.87 dB) for patient with moderate MERI, and 54.9 dB (SD 14.05 dB) for patient with severe MERI. Post operatively for mild MERI mean hearing gain is 12-14dB, for moderate MERI mean hearing gain is 10-13dB and for severe MERI mean hearing gain is 10-13dB. As compared to this study, 38(56.71%) patients had mild MERI, 27(40.29%) Patients had moderate MERI & 2(2.98%) patients had severe MERI. Patients with MERI score between 0-3, preoperative ABG was 36.49±11.80 dB, post operative ABG was 18.53±8.69 dB & hearing gain was 17.97±10.53 dB. Patients with MERI score between 4-6, preoperative ABG was 40.6±9.75 dB, post operative ABG was 31.78±13.63 dB & hearing gain was 8.82±12.55 dB. Patients with MERI score between 7-12, preoperative ABG was 35.64±11.28 dB, post operative ABG was 40.63±0 dB & hearing gain was -4.99±0 dB.

Kanagamuthu Priya et al.8 conducted study for evaluation of ETF in CSOM with reference to its treatment outcome, in which total 100 patients were enrolled. They observed that patients with normal ETF showed graft uptake 100% and those with poor ETF showed graft uptake 76%. In our study total 39 patients with normal ETF, only in 1(2.56%) patient graft was rejected & out of 28 patients with poor ETF, graft was rejected in 5(17.85%) patients.

CONCLUSION

Young and middle aged population of low socio-economic class are the most common sufferers of chronic suppurative otitis media. Tympanic membrane perforations are long standing and they are poorly treated (usually with ear drops only) by general practitioners in this group.

Mean pre-operative ABG in dry TM as per PTA is 37.97±11.08 dB. Hearing loss increases with increase in size of perforation. Patients with MERI score between 1-3 underwent tympanoplasty type I or cortical mastoidectomy with type I tympanoplasty. Patients with MERI score between 4-6 & 7-12 underwent cortical mastoidectomy type III tympanoplasty. Graft was rejected in total 6 patients out of 67 patients in which 5 patients had poor ET function & only 1 patient had normal ET function. It is concluded that there is good correlation between ET function & graft take up in tympanoplasty. In case of CSOM with totally impaired ETF patients, cortical mastoidectomy has been done to improve ventilation.

There is correlation between MERI score & hearing improvement after tympanoplasty. Patients with high MERI score underwent type III tympanoplasty having less hearing improvement compared to patients with low MERI

score who underwent type I tympanoplasty. This study clearly shows that patients staged into MERI 1-3(mild disease) have graft acceptance rate of 92%, patients with MERI score 4-6 (moderate disease) have graft acceptance rate 88% & patients with MERI score 7-12 (severe disease) have graft acceptance rate 100% which is inconclusive.

According to other studies, in patients with MERI score between 7-12, there should be 100 % graft rejection but in our study there is 100 % graft acceptance without any defect in neo tympanic membrane. There are some factors which will affect this outcome like sample size is very small, patient's age, patients immunity, use of higher antibiotics, patient's follow up so this result is inconclusive yet it is to be observed that hearing outcome in these patients is less compared to patients with MERI score between 4-6.

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