Using Middle Ear Risk Index and ET Function as Parameters for Predicting the Outcome of Tympanoplasty

Nishant Kumar · N. N. Madkikar · S. Kishve ·
Devashri Chilke · Kiran J. Shinde

Received: 11 April 2010 / Accepted: 26 September 2010 / Published online: 2 February 2011
© Association of Otolaryngologists of India 2011

Abstract Otitis media is an important and a highly prevalent disease of the middle ear and poses serious health problem world wide especially in developing countries where large percentage of the population lack specialized medical care. With a large number of patients frequently undergoing tympanoplasty for tubotympanic type of CSOM, it's important to assess the severity of the disease and predict the outcome of the surgical management whenever done. A normally functioning eustachian tube is an equally essential physiologic requirement for a healthy middle ear and normal hearing. 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.

Keywords Middle ear risk index · CSOM

Introduction

Otitis media is an important and a highly prevalent disease of the middle ear and poses serious health problem world wide especially in developing countries where large percentage of the population lack specialized medical care. With a large number of patients frequently undergoing tympanoplasty for tubotympanic type of CSOM, it's important to assess the severity of the disease and predict the outcome of the surgical management whenever done. A normally functioning eustachian tube is an equally essential physiologic requirement for a healthy middle ear and normal hearing.

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. Correlation of hearing loss with size and site of TM perforation and ossicular damage/pathology.
2. Study of MERI and result of tympanoplasty according to risk category.
3. To assess the result of surgical treatment of tubotympanic chronic suppurative otitis media and its relation to the MERI.
4. To study the effect of Eustachian tube function on result of tympanoplasty.

N. Kumar (✉) · N. N. Madkikar · S. Kishve · D. Chilke ·
K. J. Shinde

Department of Otorhinolaryngology and Head & Neck Surgery,
Pravara Rural Hospital and Medical College, Loni (BK),
Ahmednagar 413736, Maharashtra, India
e-mail: drnishant5@yahoo.co.in

N. N. Madkikar
e-mail: drnileshmadkikar@live.com

S. Kishve
e-mail: skihve@gmail.com

D. Chilke
e-mail: drnishant5@yahoo.com

K. J. Shinde
e-mail: kiranpmt@gmail.com

Materials and Methods

This was a prospective study carried out in the department of ENT & Head and Neck Surgery (HNS) in PMT Loni. All cases of tubotympanic type of CSOM in the age group 15–60 years attending ENT & HNS out patient department were included in this study. All the cases underwent detailed history taking followed by a general physical examination and examination of Ear, Nose and Throat. The relevant details were recorded and cases were then subjected to routine blood and urine examinations and a battery of Otological investigations namely

(1) Audiological tests.

- (a) Pure tone audiometry (PTA).
- (b) Speech discrimination score (SDS).

(2) Eustachian tube function (ETF).

Eustachian tube function was assessed by three ways:

- (a) Instillation of antibiotic ear drop.
- (b) Auscultation tube test.
- (c) ET functions by tympanometry.

(3) Otomicroscopy.

(4) Aural Swab for culture sensitivity.

(5) To measure the size of perforation, thin and transparent plastic paper were used and over it graphs of 1 mm² were drawn, oval pieces of about 9 × 8 mm size is cut and sterilized by keeping in cidex, under operating microscope with magnification ×15 sterile plastic with graph imprinted on it is kept over the t.m. perforation number of square occupying the perforation will be directly counted, if half or more of any square is within the perforation it is taken to be one square and if less than half of a square is within the perforation, it is not counted.

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 or myringoplasty. Preoperative assessment of status of ear before surgery (quiescent/inactive), ET function, type of hearing loss (conductive/mixed/SNHL) were done and recorded. Risk categories were derived from the MERI scoring chart given below and the severity of the disease was noted.

Surgical procedure was planned according to size of perforation.

- For small perforations, modified inlay method was used.
- For small to moderate perforations, routine underlay procedure was used.

- For large to subtotal perforations or total perforation, Three flap technique was used.
- For anterior perforations with small margin, bucket handle technique was used.

Three Follow up Visits at 21, 45 and 3 months during which assessment of graft uptake by otoscopy, subjective evaluation (hearing, tinnitus, and any other complaints); otoscopy and repeat PTA and ETF were done. These findings were then evaluated and compared with preoperative findings.

S. no.	Risk factor	Risk value
1.	Otorrhoea	
	I Dry	0
	II Occasionally wet	1
	III Persistently wet	2
	IV Wet, cleft palate	3
2.	Perforation	
	Absent	0
	Present	1
3.	Cholesteatoma	
	Absent	0
	Present	1
4.	Ossicular status (Austin/Kartush)	
	O: M + I + S+	0
	A: M + S +	1
	B: M + S–	2
	C: M – S+	3
	D: M – S–	4
	E: Ossicle head fixation	2
	F: Stapes fixation	3
5.	Middle ear granulation or effusion	
	No	0
	Yes	1
6.	Previous surgery	
	None	0
	Staged	1
	Revision	2

MERI 0, Normal; MERI 1–3, mild diseases; MERI 4–6, moderate disease; MERI 7–12, severe disease

Observations and Discussion

The present study was carried out in 50 patients (64 ears) with unilateral or bilateral perforation of tympanic membrane for a period of 2 years. All cases of tubotympanic type of CSOM were included in the study and followed up to 3 months of surgical treatment.

On ascertaining the size of tympanic membrane perforation it was observed that out of 64 ears, 6 (9.37%) were having small T.M. perforation, 28 (43.75%) were having moderate T.M. perforation, 9 (14.06%) were having large T.M. perforation and 21 (32.81%) were having subtotal or total T.M. perforation.

Maximum number of tympanic membrane perforations, involved all the four quadrants 21 (32.8%). Out of the 16 discharging ears maximum number showed a growth of *Pseudomonas aeruginosa* 8 (50%), followed by Coagulase positive staph in 2 (12.5%) cases and *Klebsiella pneumoniae* also in 2 (12.5%) cases. *Escherichia Coli* in 1 (6.26%) case on aural swab culture.

On assessing hearing loss on pure tone Audiometry it was observed that most of the patients included in the study were having pure conductive hearing loss 59 (92.18%), 5 (7.82%) ears had mixed hearing loss and none of the ears had pure sensorineural hearing loss. The total effective surface area of the tympanic membrane was taken to be 55 mm² and the sizes of perforation were categorized as:

- (i) 1–14 mm², i.e. <25% of total effective tympanic membrane surface area involved by perforation.
- (ii) 15–27 mm², i.e. 25–50% of total effective tympanic membrane surface area perforated.
- (iii) 28–41 mm², i.e. 50–75% of effective tympanic membrane surface area perforated and
- (iv) 42–55 mm², i.e. 75–100% of effective tympanic membrane surface area involved by the perforation.

Maximum numbers of ear i.e. 28 were having size of tympanic membrane perforation between 15 and 27 mm (25–50%) of effective tympanic membrane surface area with an average hearing loss of 35 dB while larger perforations involving 42–55 mm (75–100%) of effective tympanic membrane surface area suffered from an average loss of 44 dB (Table 1).

It was observed that maximum numbers of ears had all the four quadrants involved by the perforation i.e. in 21 (32.8%) ears, and on correlating the hearing loss according to site of tympanic membrane perforation, maximum average hearing loss 44.6 dB was in the perforations involving all the four quadrants, followed by three quadrant

Table 1 Hearing loss according to tympanic membrane involvement, i.e. area occupied by perforation ($N = 64$)

Size of perforation in mm ²	% of TM involved by perforation.	No. of ears	Average hearing loss (dB)
1–14	<25	6	28.23
15–27	25–50	28	32.42
28–41	50–75	9	36.26
42–55	75–100	21	44.62

Table 2 Site of tympanic membrane perforation according to quadrant involved by perforation ($N = 64$)

Site of perforation according to quadrant	No. of ears	Percentage
AI	3	4.68
PI	3	4.68
AS + AI	10	15.62
PS + PI	6	9.37
AI + PI	12	18.75
AS + AI + PI	9	14.06
AS + AI + PS + PI	21	32.8

perforations i.e., (AS + AI + PI) and PS + PI perforation. (Table 2)

Out of 64 ears 7 ears had ossicular chain pathology, handle of malleus was eroded in 4 (6.25%) cases and long process of incus was eroded in 3 (4.68%) cases. An average hearing loss was 46.6 dB in perforations with handle of malleus erosion and 54.3 dB in ears with long process of incus erosion was observed. We also observed that malleolar perforations had significantly greater hearing loss than non malleolar perforations. In perforations occupying <25% of T.M. surface area, the difference is mean average hearing losses of malleolar and non malleolar perforations was 3.41 dB which was statistically significant. ($z = 2.72$; $P < 0.01$). It was 3.8 dB in cases of perforations occupying 25–50% of effective surface area of T.M. which was also statistically significant ($z = 5$; $P < 0.01$).

The assessments of eustachian tube function by antibiotic ear drop instillation, auscultation of tube and ETF by Impedance audiometer were compared. It was observed that out of 50 ears, 38 ears had normal ETF by all the three methods i.e. antibiotic ear drop instillation, auscultation tube & ETF by impedance audiometry. Out of 12 ears with Eustachian tube dysfunction, four had ETD by all the three methods, six ears by means of Impedance audiometry & two by only antibiotic instillation.

It was observed that out of 38 ears with normal Eustachian tube function, graft was accepted in 34 (89.47%) of cases and rejected in 4 (10.52%) of cases probably because of severe URTI and in compliance of the patient to proper post operative care advised on discharge.

Whereas in case of ears with Eustachian tube dysfunction i.e. 12 ears, graft was accepted in 6 (50%) cases & rejected in 6 (50%) cases.

According to this MERI Index carried out for the 50 ears studied, suggested risk categories and no. of ears that fall in each category and result of tympanoplasty according to MERI score was assessed.

It was observed that maximum number of ears 36 (72%) fall under MERI 1–3 i.e. mild disease followed by 12

Table 3 suggested risk categories and no. of ears that fall in each category along with result of tympanoplasty according to MERI index ($N = 50$)

Risk category	No. of ears		Result of tympanoplasty			
	No.	% age	Successful		Unsuccessful	
			Graft accepted	% age	Graft rejected.	% age
MERI 0	0	0	0	0	0	0
MERI 1–3	36	72	31	86	5	13.8
MERI 4–7	12	24	9	75	3	25
MERI 7–12	2	4	0	0	2	100

(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.

On comparing the result of tympanoplasty it was observed that ears which fall under risk category of MERI 1–3 i.e. mild disease was best i.e. 86% followed by MERI 4–6 moderate disease i.e. 75%, ears with MERI score of 7–12 i.e. severe disease none of the ear accepted the graft. (Table 3)

During the study period 50 tympanoplasties were performed by the same ENT surgeon and in the same setup and result was assessed as below.

Graft Uptake Rate

Out of 50 patients who underwent tympanoplasty during the study period, graft was accepted in 40 (80%) patients and rejected in 10 (20%) patients. On assessing the cause of graft rejection in 10 patients it was observed that 6 patients were having eustachian tube dysfunction, 2 patients were having MERI score of 7–12 i.e. severe disease, and 2 patient developed post operative upper respiratory tract infection.

Improvement in Hearing Following Surgery

Pre operative and post operative audiometric pattern of 40 patients with healed graft were compared and the amount of air bone gap closure achieved was noted. It was observed that maximum number of ears 33 (82.5%) achieved air bone gap closure of 0–10 dB.

On correlating average hearing gain postoperatively with eustachian tube function in the ears with healed graft i.e. 40 ears. It was observed that in ears with normal eustachian tube function post operative hearing gain was 62.4% whereas in ears with eustachian tube dysfunction post operative hearing gain was 51.8%.

Of the 50 tympanoplasties performed, 26 were done by endaural approach using 3-flap technique, 16 were done by

Table 4 Result of tympanoplasty by different techniques used ($N = 50$)

Technique	No. of ears	%	Graft accepted	%	Graft rejected	%
3-Flap	26	52	21	80.76	5	19.23
Routine underlay	16	32	12	75.00	4	25.00
Bucket handle	5	10	4	80.00	1	20.00
Modified inlay	3	6	3	100	0	0

post aural approach using routine underlay technique, 5 was done by post aural approach using bucket handle technique and 3 were done modified inlay technique (Table 4).

Conclusion

Young and middle aged population of low socio-economic class are the most common sufferers of 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.

Hearing losses as on PTA in dry T.M. perforations range from 16–46 dB (conductive) and roughly 2/3 of the cases have mild conductive hearing loss. Average hearing loss has been observed to be greater at lower frequencies than at higher frequencies.

Malleolar perforations reveal greater hearing loss a compared to non malleolar ones (even if both are of identical size).

Hearing loss increases with the increase in the size of tympanic membrane perforation. Site of perforation is also an important factor as posterior quadrant pars tensa perforations have greater hearing loss than anterior quadrant perforations. The study clearly shows that ears that are staged into MERI 1–3 i.e. mild disease have a graft acceptance rate of 86%, and ears termed to have a severe disease i.e. MERI 7–12 have a 100% chance of graft rejection. Hence from the present study it can be confidently concluded that MERI scoring can be useful in predicting the outcome of tympanoplasty.

Roughly 1/3rd cases of safe CSOM with dry T.M. perforation have normally functioning Eustachian tube and slightly less than 50% have only mild dysfunction as noted by Eustachian tube opening pressure.

It is concluded that a good correlation exists between the functional status of eustachian tube and success of myringoplasty operation. The success rates of myringoplasty in normal E.T. function (81.8%) and in mild E.T. hypofunction (72.7%) are significant as compared to failures in the presence of moderate and severe E.T. hypofunction, whatever may be the technique.