Evaluation of Role of Mastoid Surgery in the Management of Safe Chronic Suppurative Otitis Media

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Abstract This study evaluates the outcome of type 1 tympanoplasty with and without mastoidectomy. The comparative study comprises of 40 patients with CSOM safe type in dry ear. All cases were operated during a period of one and a half years. 20 of these cases were selected for tympanoplasty alone (Group A) and 20 cases were selected for Tympanoplasty with cortical mastoidectomy (Group B). Patients were reviewed after 3 weeks for inspection of the operated ear. The second and third post-operative reviews were done 6 and 12 weeks respectively for clinical assessment of the operated ear with respect to graft status, ear discharge and hearing improvement. The postoperative audiograms were recorded after 3 months. Type I tympanoplasty with cortical mastoidectomy has better graft uptake (100 %) as compared to without mastoidectomy (95 %). Post-operative A–B gap closure is better in tympano-mastoidectomy (20.48 dB) than tympanoplasty (15.75 dB) with p value <0.05 . Post-operative hearing gain and graft uptake were both better with tympano-mastoidectomy and tympanoplasty.

Keywords CSOM · Tympanoplasty · Tympano-mastoidectomy · Mastoid pneumatization

Introduction

Otitis media is an inflammation of a part or whole of the mucoperiosteal lining of the middle ear cleft which is composed of eustachian tube, hypotympanum, mesotympanum, epitympanum, aditus and mastoid air cells [1]. It is one of the commonest ear disease of all age groups and it is caused by multiple interrelated factors including infections, eustachian tube dysfunction, nasal allergy and trauma. The disease has been classified on the basis of its underlying pathology as active or inactive mucosal, active or inactive squamous and healed chronic otitis media [2]. According to Jackler and Schindler [3] many factors contribute to success or failure of surgery which are divided into mastoid and non mastoid factors. Non mastoid factors are age, general debility, eustachian tube dysfunction, septic focus in non mastoid areas, cochlear reserve and ossicular chain status. Mastoid factors are extent of pneumatization and presence of inflammatory disease in mastoid. Holmquist and Bergstorm [4] in 1978 said that well aerated mastoid is a prerequisite for well ventilated middle ear and long lasting success. The surgical methods and indication of tympanoplasty have come a long way since the days of Wullestein [5] who in year 1953 coined and described tympanoplasty as repair of the tympanic membrane using split thickness graft. Role of cortical mastoidectomy in tympanoplasty for dry tubotympanic disease is controversial. Those arguing in favor suggest that cortical mastoidectomy increases the air reservoir in the mastoid and also help in achieving the patency of aditus but the rationale use for the addition of simple mastoidectomy to tympanoplasty does not universally accepted, with the fear that an unoccluded antrum would invite the ingrowth of squamous epithelium. Others believe that the potential for injury to the inner ear structures and facial nerve during

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mastoid surgery outweighs the beneficial effects on tympanic membrane healing [1].

Aims and Objectives

1. To study the status of pneumatization of mastoid in relation to tubotympanic disease.
2. To assess the graft uptake in patients undergoing tympanoplasty and tympanomastoidectomy in dry tubotympanic disease.
3. To compare the hearing improvement in patients undergoing tympanoplasty and tympanomastoidectomy in dry tubotympanic disease.

Materials and Methods

The present prospective study was conducted in the Department of Otorhinolaryngology, MMIMSR, Mullana. The total number of cases included in the study was 40.

Inclusion criteria:

1. Patients between the age group of 13–65 years.
2. Patients with dry tubo-tympanic CSOM.

Exclusion criteria:

1. Age below 13 years and above 65 years.
2. Patients with previous history of ear surgery.
3. Patients with sensorineural hearing loss or mixed hearing loss.
4. Patients with other systemic disease (diabetes).
5. Patients with cholesteatoma.

Methodology

A detailed history followed by general physical and detailed ENT examination was done in all patients. Following this a clinical diagnosis was made. These cases were subjected to routine investigations (Complete Blood count and Urine analysis) and specific investigations (viz. pure tone audiometry, Eustachian tube function by impedance audiometry, otomicroscopy and radiology).

Details of Specific Investigations

1. *Audiological tests:* Pure Tone Audiometry (PTA) was done by ALPS Advanced Digital Audiometer AD2100 in a sound proof room.
2. *Eustachian tube functions:* Tympanometry (Toynbee's test).
3. *Otomicroscopy:* Patient will undergo microscopic examination to reconfirm the otoscopic finding, middle

ear mucosal status, middle ear epithelization and status of attic region.

4. *Radiology:* All patients had undergone X-ray Mastoid–Schuller's view to see for the status of pneumatization of mastoid and findings were recorded as well pneumatized, diploic and sclerotic. Diploic and sclerotic mastoids were considered small mastoids while well pneumatized were considered large mastoids.

Depending on the clinical diagnosis of dry and tubotympanic disease (Quiescent/Inactive) and mastoid pneumatization of the patient they were divided into two groups. All patients had normal Eustachian tube function.

- Group A—20 out of 40 patients underwent tympanoplasty.
- Group B—The remaining 20 patients underwent tympanomastoidectomy.

15 out of 20 patients in both the groups were observed to have a small mastoid and the remaining 5 patients in both the groups had large mastoids.

Treatment

Conservative All the patients with minimal ear discharge were treated conservatively using oral antibiotics (Amoxycillin/Cefixime + Clavulanic acid/Ciprofloxacin) and combination of antihistaminics and decongestants (cetirizine and pseudoephedrine). The ear was dry for a minimum of 4 weeks before the patient was posted for surgery.

Surgical The patients were admitted a day before surgery.

Preoperative Preparation

1. Written and informed consent before surgery was taken.
2. Xylocaine sensitivity test was done.
3. Inj. T.T 0.5 ml I.M stat was given.
4. Preparation of part: Shaving of hair in postaural area to be operated (up to 3 cm above and behind of post aural sulcus) was done.
5. Patient was kept NPO for 6 h before surgery.

Anaesthesia

Surgery was done under General Anaesthesia.

Two percent xylocaine with adrenaline (1:100,000) was infiltrated in the post aural sulcus as well as in the external auditory canal at the cartilaginous—osseous junction in all four canal walls.

Surgical Procedure

1. Tympanoplasty Routine postaural incision was given. Temporalis fascia graft was harvested. Meatal incision was given from 12 to 4'O clock position. Margins of perforation were freshened. Tympanomeatal flap was elevated circumferentially. Superiorly and anteriorly the flap is elevated from medial to laterally using first incision knife. Middle ear was inspected for pathology (fibrous band, granulations and ossicular erosion). Ossicular chain continuity was ascertained. If posteriorly superior part is not well visualized the bony overhang was removed using curette or burr. Finally graft was laid by underlay method. EAC was packed with gel foam impregnated with ciprofloxacin ointment and wound closed in layers after achieving adequate hemostasis. Mastoid bandage was given.

2. Tympanomastoidectomy The only addition to the entirely same procedure of tympanoplasty was to carry out cortical mastoidectomy.

Post-Operative Care: Patient was watched for soakage of dressing, vertigo, facial paralysis, fever, otalgia, headache and tinnitus. Patient was discharged after 7 days after removal of stitches and then called on 21st post-operative day (15 days later) for removal for gel foam and inspection of graft.

Follow Up Visits

First visit was at 21 days post op for removal of cotton plug and gel foam, status of post aural wound (Healthy/gaping/stitch abscess), subjective evaluation (hearing, tinnitus, other complaints), assessment of graft uptake by otoscopy. Patients were advised to start a topical antibiotic ear drops (Ciprofloxacin).

Second visit was at one and half month post-operative for subjective evaluation (hearing, tinnitus, any other complaints) and post aural wound and status of graft by otoscopy/otomicroscopy.

Third visit was at 3 months post op for subjective evaluation and PTA was repeated.

These findings were then evaluated and compared with preoperative findings.

Observations Our study included 40 patients of tubotympanic type of CSOM. Patients underwent tympanoplasty and tympanomastoidectomy on the basis of pneumatization of the mastoid seen on X-rays.

Age and Sex Incidence Figure 1 show age incidence of patients in series ranged from 13 to 65 years. The maximum number of patients 22 (55 %) were in the age group of 30–49 years followed by 20,17.5 and 7.5 % seen in the

age group of 10–19, 20–29 and 50–59 years respectively. Figure 1 indicates that as the age increases above 40 years incidence of CSOM decreases. Figure 2 shows the gender incidence of the disease.

Ear Involved Figure 3 show that right ear involvement was seen in 24 (60 %) cases. The left ear was seen to be involved in 16 (40 %) of the cases. Out of the 40 cases, the disease was unilateral in 33 (82.5 %) patients and bilateral only in 7 (17.5 %) patients.

Duration of Ear Discharge Figure 4 show duration of ear discharge with which the patients presented. In maximum number of patients, 18 (45 %), the duration of ear discharge was 1–5 years, followed by 27.5 and 17.5 % of the patients where the duration was seen to be 5–10 and >10 years respectively. Data clearly indicates the ignorance of the ear disease as majority of the cases (90 %) had a history of ear discharge for more than 1 year.

Size of Perforation The most common type of perforation seen was large central. (47.5 %), followed by medium, subtotal and small perforations seen in 27.5, 15 and 10 % of the patients respectively (Fig. 5).

Pre-op Audiological Assessment In our study preoperative mean A–B gap in Groups A and B was (28.48 ± 10.42 dB) and (32.20 ± 9.60 dB) respectively. The preoperative AC threshold was (38.29 ± 12.76) and (41.72 ± 11.94) for Group A (patients undergoing tympanoplasty) and Group B (patients undergoing tympanomastoidectomy) respectively (Table 1).

Mastoid Pneumatization Radiologic condition was noted in every patient. Pneumatic mastoid was observed in 10

Fig. 1 Age incidence

Fig. 2 Gender incidence **Fig. 3** Ear involved **Fig. 4** Duration of ear discharge

(25 %) patients and sclerotic mastoid in 30 (75 %) patients (Images 1 and 2).

Graft Uptake Table 7 and Fig. 5 shows the status of graft at 3 months follow up. Results were taken as positive if

Fig. 5 Size of perforation**Table 1** Pre-op audiological assessment

	Group A	Group B
Pre-op AB GAP (mean $\pm$ SD)	28.47 $\pm$ 10.42	32.20 $\pm$ 9.60
Pre-op AC TH (mean $\pm$ SD)	38.29 $\pm$ 12.76	41.72 $\pm$ 11.94

Table 2 Graft uptake

	Group A			Group B		
	Positive	Negative	Group total	Positive	Negative	Group total
Numbers	19	1	20	20	0	20
Percentage	95	5	100	100	0	100

Table 3 Post-op audiological assessment (AC)

	Group A	Group B	<i>p</i> value
<i>Post-op audiological assessment (AC)</i>			
Pre Op ACTH (mean $\pm$ SD)	38.29 $\pm$ 12.76	41.72 $\pm$ 11.94	0.385
Post Op ACTH (mean $\pm$ SD)	21.33 $\pm$ 10.83	21.44 $\pm$ 7.20	0.97
ACTH gain (mean $\pm$ SD)	16.93 $\pm$ 7.92	20.78 $\pm$ 8.31	0.142

graft was taken up and negative if it was not taken up. Above Table 7 shows graft uptake at 3 months postoperatively. It shows that in Group A graft take up rate was 95 %; in Group B it was 100 % (Table 2).

Post-op Audiological Assessment (AC) The average gain in air conduction threshold was 16.93 $\pm$ 7.92 in patients who had undergone tympanoplasty while the gain seen in patients who had undergone tympanomastoidectomy was 20.78 $\pm$ 8.31. However this was not statistically significant (Table 3).

Table 4 Post-op audiological assessment (A–B gap)

	Group A	Group B	<i>p</i> value
<i>Post-op audiological assessment (A–B gap)</i>			
Pre op A–B gap (mean $\pm$ SD)	28.48 $\pm$ 10.42	32.20 $\pm$ 9.60	0.25
Post op A–B gap (mean $\pm$ SD)	12.46 $\pm$ 8.46	11.72 $\pm$ 5.90	0.75
A–B gap gain (mean $\pm$ SD)	15.75 $\pm$ 6.86	20.48 $\pm$ 6.20	0.028

Table 5 Small mastoid (ABG)

	Group A	Group B	<i>p</i> value
Pre op A–B gap (mean $\pm$ SD)	29.00 $\pm$ 9.95	34.29 $\pm$ 9.59	0.157
Post op A–B gap (mean $\pm$ SD)	12.74 $\pm$ 8.86	12.29 $\pm$ 6.44	0.876
A–B gap gain (mean $\pm$ SD)	15.88 $\pm$ 6.92	22.00 $\pm$ 5.65	0.013

Post-op Audiological Assessment (A–B Gap) In our study preoperative mean A–B gap in Groups A and B was (28.48 $\pm$ 10.42 dB) and (32.20 $\pm$ 9.60 dB) respectively. Postoperatively mean AB gap was (12.46 $\pm$ 8.46 dB) in Group A and (11.72 $\pm$ 5.90 dB) in Group B. Overall AB gap gain was (15.75 $\pm$ 6.86 dB) for Group A and (20.48 $\pm$ 6.20) for Group B (Table 4).

Small Mastoid (ABG) The A–B Gap gain in patients with small mastoid was 15.88 $\pm$ 6.92 and 22.00 $\pm$ 5.65 in Group A and Group B respectively. In patients with large mastoid, the A–B gap gain was seen to be 15.38 dB with Group A and 15.94 dB with Group B (Table 5).

Discussion

Chronic suppurative otitis media is a persistent disease capable of causing destruction of middle ear structure with irreversible sequelae which manifests as deafness and discharge [6]. In the present study, 40 patients in the age group of 13–65 years of either sex normal eustachian tube function were selected from Ear, Nose and Throat Outpatient Department of MMIMSR, Mullana, Ambala. A detailed history, clinical examination and investigations were done as per the performa attached. Pure tone audiometry was done to assess hearing loss.

Age Incidence In our study, the age group ranged from 13 to 65 years. All the patients were above 13 years of age with maximum number of patients (22) being between the age group of 30–49 years. Patients below 13 years were excluded from this study because of generally high incidence of upper respiratory tract infections. Glasscock [7] gave young age as relative contraindication to

tympanoplasty because younger children under the age of 3–4 years are prone to respiratory tract infections and recurrent attacks of otitis media. In a study by Chavan et al. [1] the mean age of presentation was observed to be 28 years. The mean age of patients in our study was 34 years.

Sex Distribution In our series there was female preponderance as compared to male patients. Overall 67.5 % were females while rest of patients was males. In the study carried by Awan et al. [8] 53.3 % subjects were females while 46.7 were males. In study by Kontantinidis et al. [9] male preponderance in the subjects was seen. There were 66.7 % males and 33.3 % female.

Ear Involved The right ear was observed to be involved in 60 % of the cases in our study, while in a study conducted by Chavan et al. [1] the left ear involvement was seen in 52 % of the cases.

Duration of Ear Discharge In a study conducted by Kabdwal et al. [10], 37.5 % of the patients presented with a history of ear discharge for 10–15 years. However in our study, majority of the patients presented with history of discharge for 1–5 years i.e. 18 (45.0 %). Out of 40 patients, 4 patients (10 %) gave history of ear discharge for a duration of less than a year, 11 (27.5 %) had a history of discharge between 1 and 5 years and 7 (17.5 %) patients presented with a history of discharge for more than 10 years. Longer duration of ear discharge shows lack of awareness about the disease and its complications. Our study also revealed that the most common type of perforation seen was the large central type seen in 19 out of 40 patients (47.5).

Radiological Condition of Mastoid Radiologic condition was noted in every patient. Pneumatic mastoid was observed in 25 % patients and sclerotic mastoid in 75 % of the patients in our study, while 93 % of the patients in the study done by Kabdwal et al. [10] were observed to have a sclerotic mastoid (Images 1 and 2).

Graft Uptake In the present study, the success was defined as intact graft at least 3 months postoperatively. The success rate was in terms of graft uptake rate which was 95 % with tympanoplasty, and 100 % with tympanomastoidectomy. These findings were consistent with those of the study done by Chavan et al. [1]. It was observed that the success rate of graft uptake was also seen to be 100 % with tympanomastoidectomy in the studies conducted by Nayak et al. [11] and Ashok et al. [12]. However in the study conducted by Yasuo et al. [13] the graft uptake was seen to be slightly better with tympanoplasty (94.4 %) than with tympanomastoidectomy (90.7 %) Table 6.

Table 6 Graft uptake

Study	No. of cases	Group A Tympanoplasty (%)	Group B Tympanomastoidectomy (%)
Ruhl and Pensak [15]	135	–	90.4
Yasuo et al. [13]	251	94.4	90.7
Nayak et al. [11]	40	60	100
Ashok et al. [12]	40	75–80	100
Chavan et al. [1]	150	93.33	97.33
Present study	40	95	100

Table 7 Hearing improvement

Study	No. of subjects	Hearing improvement	
		Tympanoplasty	Tympanomastoidectomy
Kabdwal et al. [10]	57	7.8 dB	3.5 dB
Goyal [14]		14 dB	7.93
Present study	40	15.75	20.48

Hearing Improvement According to a study conducted by Kabdwal et al. [10] the average hearing gain in patients who underwent tympanoplasty alone was 7.8 dB and the gain in patients who underwent tympanomastoidectomy was 3.5 dB. However in our study, we observed that the hearing gain in patients undergoing tympanomastoidectomy was 20.48 dB and the gain seen in patients undergoing tympanoplasty was 15.75 dB. This was seen to be statistically significant up to a level of 5 %. Goyal [14] found an average hearing gain in both Group-A (type-I tympanoplasty) and Group-B (type-I tympanoplasty with cortical mastoidectomy), which was also similar to the findings of our study in Group-A (tympanoplasty) Table 7.

In our study preoperative mean A–B gap in Groups A and B was (28.48 ± 10.42 dB) and (32.20 ± 9.60 dB) respectively. Postoperatively mean AB gap was (12.46 ± 8.46 dB) in Group A and (11.72 ± 5.90 dB) in Group B. Overall AB gap gain was (15.75 ± 6.86 dB) for Group A and (20.48 ± 6.20) for Group B. Hence there was a significant improvement seen in the ABG in our study in patients who underwent tympanomastoidectomy.

The average gain in air conduction threshold was 16.93 ± 7.92 in patients who had undergone tympanoplasty while the gain seen in patients who had undergone tympanomastoidectomy was 20.78 ± 8.30 . However this was not statistically significant.

In our study we achieved satisfactory anatomical and hearing gain results which are comparable to other reported studies in the literature.

These findings are consistent with those of Saha et al. [12], who also witnessed hearing gain postoperatively in all cases undergoing type-I tympanoplasty (Group-A) and simple mastoidectomy with tympanoplasty (Group-B).

Summary and Conclusion

40 patients of dry (quiescent and inactive) tubotympanic disease in age group between 13 and 65 years of age were selected from E.N.T O.P.D of MMIMSR Mullana, Ambala for the present study. The patients selected were of either sex and were thoroughly assessed by the detailed history and otological examination. Preoperative pure tone audiometry was done and X-ray mastoid (schuller's view) was obtained.

- The maximum number of patients 22 (55 %) were in the age group of 30–49 years.
- 67.5 % of the patients in our study were female and rest of the patients was male. Hence, female preponderance was seen.
- Out of the 40 cases, the disease was unilateral in 33 (82.5 %) patients and bilateral only in 7 (17.5 %) patients.
- Right ear involvement was seen in 24 (60 %) cases.
- In maximum number of patients, 18 (45 %), the duration of ear discharge was seen to be 1–5 years.
- 40 patients were divided into two groups, Group A and Group B, comprising 20 patients each.
- Patients in Group A underwent tympanoplasty and those in Group B underwent tympanomastoidectomy.
- The preoperative mean A–B gap in Group A and B was (28.48 ± 10.42 dB) and (12.46 ± 8.46 dB) respectively. The preoperative AC threshold was (38.29 ± 12.76) and (41.72 ± 11.94) for Group A and Group B respectively. The most common type of perforation seen was large central (48 %).
- Radiologic condition was noted in every patient. Pneumatic mastoid was observed in 10 (25 %) patients and sclerotic mastoid in 30 (75 %) patients.
- It was observed that in Group A graft take up rate was 95 % whereas in Group B it was 100 %.
- The average gain in air conduction threshold was 16.93 ± 7.92 in patients who had undergone tympanoplasty while the gain seen in patients who had undergone tympanomastoidectomy was 20.78 ± 8.3 . However this was not statistically significant.
- The preoperative mean A–B gap in Group A and B was (28.48 ± 10.42 dB) and (12.46 ± 8.46 dB) respectively. Postoperatively mean AB gap was (12.46 ± 8.46 dB) in Group A and (11.72 ± 5.90 dB) in Group B. Overall AB gap gain was

(15.75 ± 6.86 dB) for Group A and (20.48 ± 6.20) for Group B. Hence there was a significant improvement seen in the ABG seen in the study in patients who underwent tympano-mastoidectomy.

- The ABG gain in patients with small mastoid was 15.88 ± 6.92 and 22.00 ± 5.65 in Group A and Group B respectively. This was seen to be statistically significant up to a level of 5 %.

Evaluating our observation in the light of available literature we concluded that hypocellularity of the mastoid process has a strong correlation with the tubotympanic type of CSOM. Addressing the mastoid region by mastoidectomy has beneficial effect on the post operative hearing gain and graft uptake. To establish strong indication and statistical significance about role of mastoidectomy, it requires large sample size and multicenter study.

Compliance with Ethical Standards

Conflict of interest There is no conflict of interest and there is no financial disclosure. Detailed written consent was taken from all the patients who have participated in the study pre-operatively.

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