Original Research

Does Eustachian tube patency affect the outcome of graft uptake rate and average audiological gain in Intact canal wall and Canal wall down Mastoidectomies – A study of 50 patients

Mehtab Alam, Satish Chandra Sharma, Syed Abrar Hasan

Department of Otorhinolaryngology, JN Medical College, A.M.U, Aligarh, Uttara Pradesh, India
Correspondence to: Mehtab Alam, E-mail: mehtabalam4105@gmail.com

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Abstract

Background: Cholesteatomatous otitis media is a surgical disease managed either by Intact Canal Wall (ICW) or Canal Wall Down (CWD) mastoidectomy, depending upon the extent of cholesteatoma. The status of the eustachian tube relates to the pathogenesis of cholesteatoma and affects the surgical outcome in terms of recurrence of the disease, postoperative audiological gain, and graft uptake rates.

Objective: To compare ICW against CWD mastoidectomies with tympanoplasty, in terms of hearing gain and graft uptake rates, based on the status of eustachian tube (patent/ blocked).

Materials and Methods: The study comprised of 50 patients , who underwent either ICW or CWD mastoidectomy with tympanoplasty in the department of Otorhinolaryngology, J N Medical College, A.M.U Aligarh from September 2010 to August 2013, with a mean follow-up of 18 months. The Eustachian tube was patent in 30 (60%) cases and blocked in 20 (40%) cases. Chi-square and unpaired t-tests were used to analyze the results. The *p*-value of <0.05 was considered to be significant.

Results: In ICW mastoidectomy with tympanoplasty, there is a significant difference in average audiological gain between patients with patent eustachian tube and those with blocked (p=0.022, t=2.63), while no significant difference was seen in graft uptake rate (p=0.629). While in CWD mastoidectomy group there was no significant difference between average audiological gain (p>0.05, t=1.73) and graft uptake rate (p=0.711), between patients with patent eustachian tube and those with blocked .

Conclusion: The patency of eustachian tube plays a role in the outcome of mastoidectomies in regard to audiological gain.

KEY WORDS: Eustachian tube patency, Intact canal wall (ICW) mastoidectomy, Canal wall down (CWD) mastoidectomy, Audiological gain, Graft uptake rate

Introduction

Cholesteatoma (keratoma) represents the presence of a non-neoplastic accumulation of keratinizing stratified squamous epithelium along with desquamated keratin debris in the tympanic cavity and/or mastoid. Once the squamous epithelium reaches these areas from its origin in the external auditory canal or tympanic membrane, a locally invasive and destructive process typically ensues. Surgical therapy is the mainstay of management. The principal controversy surrounding ICW versus CWD mastoidectomy for removal of disease, and results of these two methods are being reviewed. The primary surgical objective is the eradication of all diseased tissue and establishment of a dry, safe ear. Maintenance or restoration of hearing is a secondary goal. Management of cholesteatoma requires prolonged, diligent postoperative follow-up due to the significant rate of recidivistic disease.

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The importance of Eustachian tube dysfunction (ETD) as it relates to the pathogenesis of middle ear disease and cholesteatoma cannot be overstated. ETD leads to the development of retraction pockets in the tympanic membrane, setting the stage for the genesis of cholesteatoma, which appears to be a result of propagation of inflammatory process that has been set into motion.[1] Poor tubal function plays an essential role in recurrent disease and failure of surgical therapy.

The most recent grand rounds concerning the topic of otitis media presented an excellent overview of anatomy and physiology of eustachian tube. The main functions of the eustachian tube include pressure regulation, protection, and clearance. Failure of any one or all of these functions may lead to persistent negative middle ear pressure, effusion, and tympanic membrane retraction. Wide excursions in middle ear pressure may lead to tympanic membrane atrophy, atelectasis, retraction pocket formation, or perforation. Tympanic membrane pathology is most likely to occur in the attic, and the degree of pathology usually correlates with the degree of eustachian tube dysfunction.

Tubal function and middle ear aeration are particularly important in terms of postoperative hearing results. Tos et al.[2] assessed hearing results 3 to 9 months postoperatively in children treated for cholesteatoma and chronic otitis media. A significantly better hearing was noted in those patients with a positive preoperative Valsalva's maneuver when compared with those with a negative Valsalva's maneuver.

Materials and Methods

This study was carried out in the department of Otorhinolaryngology, jawaharlal nehru medical College, AMU aligarh, from September 2010 to August 2013, with a mean follow-up of 18 months. The study comprised of 50 patients suffering from an unsafe type of chronic suppurative otitis media. There were 30 males and 20 females. The male-female ratio in this study was 3:2. When individual techniques were taken into consideration, in closed or intact canal wall (ICW) mastoidectomy the number of males and females were 11 each (1:1). On the other hand, 18 males and 10 females figured in open or canal wall down mastoidectomy (CWD) (1.8:1) (Table 1).

All the patients underwent mastoidectomy with tympanoplasty using temporalis fascia graft. In 22 cases with localized cholesteatoma, ICW mastoidectomy was performed, while cases with extensive cholesteatoma were treated with CWD mastoidectomy in 28 cases (56%).

Criteria for selection of subjects:

1. Patients suffering from unilateral or bilateral chronic suppurative otitis media unsafe type.
2. Patients between 6 to 45 years of age.
3. Patients with adequate cochlear reserve.

Criteria for exclusion:

1. Patients with sensorineural deafness.
2. Patients found to have systemic disease e.g. hypertension, diabetes mellitus.
3. Patients with Adenotonsillitis, cleft palate, nasal polyp.
4. Patients with intracranial complications of chronic suppurative otitis media.

Assessment of the eustachian tube patency was done preoperatively in every patient by Valsalva's maneuver and tubal catheterization.

The eustachian tube was found patent in 30 cases (60%) and blocked in 20(40%) cases (Table 2).

Preoperatively all patients were subjected to pure tone audiometry (PTA). The air-bone gap was calculated. The hearing loss ranged from a minimum of 18.8 dB to a maximum of 54.62 dB.

Regarding reporting of the results of hearing outcome the following guidelines for air-bone closures were used -

0 to 10 dB excellent
10 to 20 dB, good
20 to 30 dB, fair
>30 dB, poor.

χ^2 (Chi-square) and unpaired t-test were used to analyze the results. The *P* value of <0.05 was considered to be significant.

Results

In ICW mastoidectomy with tympanoplasty, the ears with patent eustachian tube showed a graft uptake in 71.4% with an average audiological gain of 9.5 dB. While in those with blocked eustachian tube, the graft uptake was seen in 50% with an audiological gain of 7.7 dB. There is a significant difference in average audiological gain between patients with patent eustachian tube and those with blocked (p=0.022, t=2.63) .While no significant difference is seen in graft uptake (p=0.629) (Table 3).

In CWD mastoidectomy with tympanoplasty, the ears with patent eustachian tube showed a graft uptake in 44.5% with an average audiological gain of 3.34 dB. While in those with blocked eustachian tube, the graft uptake was seen in 33.4% with an audiological gain of 2.54 dB. There is no significant difference in average audiological gain (t=1.73, p>0.05) and graft uptake (p=0.711) between patients with patent eustachian tube and those with blocked eustachian tube (Table 4).

Table 1: Distribution of patients according to age

Sex	I.C.W	C.W.D
Male	11	18
Female	11	10

Table 2: Distribution of patients according to status of Eustachian tube

Eustachian tube	No of Patients	(%)
Patent	30	60
Blocked	20	40

Table 3: Effect of eustachian tube dysfunction on tympanoplasty outcome in i.cwmastoidectomy

Eustachian tube	No of patients	Total no. of graft take-up*	Graft take up rate	Average audiological gain Db**
Patent	14(28%)	10	71.4 %	9.50
Blocked	8(16%)	4	50 %	7.70

*χ^2 = 0.232, p=0.629
**t=2.63, p=0.022

Table 4: Effect of eustachian tube dysfunction on tympanoplasty outcome in C.W.d mastoidectomy

Eustachian tube	No of patients	Total no. of graft take-up*	Graft take up rate	Average audiological gain Db**
Patent	16(32%)	7	44.5 %	3.34
Blocked	12(24%)	4	33.4 %	2.54

*χ^2 = 0.138, p=0.711
**t=1.73, p>0.05

Discussion

The management of chronic suppurative otitis media is in principle is a surgical endeavor to remove all diseased mucosa from the middle ear cleft and an attempt at restoration of hearing. Tympanoplasty and mastoidectomy myriad variations and combinations are the mainstays of operative interventions in the middle ear.

In the present study, all the cases of cholesteatoma were divided into two groups depending upon the extent of cholesteatoma. The group with limited disease underwent icw tympanoplasty while extensive cholesteatomas were managed by CWD mastoidectomy.

Aeration of the middle ear, a function of Eustachian tube, is critical to the success of any tympanoplasty procedure. Aeration allows the tympanic membrane, ossicles, and round window to move. Clinical experience has shown that non-_aerated ears often demonstrate 40 to 60 dB air-bone gaps.[3] A large gap in non-aerated ears occurs because ossicular coupling is greatly reduced and stapes motion is reduced because the round window membrane cannot move freely. Model analyses of the effects of varying the volume of the middle ear and mastoid, predict an increasing low frequency hearing loss as air volume is reduced.[4] The normal, average volume of the middle ear and mastoid is 6 cc; a combined middle ear and mastoid volume of 0.4cc is predicted to result in a 10dB conductive hearing loss. Volumes smaller than 0.4 cc should lead to progressively larger gaps, whereas increases in volume above 1.0 cc should provide little additional acoustic benefit. In a CWD mastoidectomy, the bony tympanic annulus and much of the ear canal are removed, and the tympanic membrane graft is placed onto the facial ridge and medial attic wall. This results in a significant reduction in the size of the residual middle ear air space

A CWD procedure also results in the creation of a large air space lateral and posterior to the eardrum, that is, the air space within the mastoid bowl including the external auditory canal. This mastoid bowl and ear canal air space generate resonances that can influence middle ear sound transmission favorably or unfavorably.[5] The structure and functional relationships between the size and shape of the mastoid cavity and cavity resonances have not been well defined. An improved understanding of this issue may help Otosurgeons to configure mastoid cavities in ways that are acoustically beneficial.

The results of hearing reported in the literature are contrasting. Paparella et al[6] and, Ragheb et al[7] in their studies found better hearing results in Canal wall up tympanoplasty. Other studies[1,8] did not find significant differences between CWD and ICW tympanoplasty.

Evaluation of eustachian tube function before the patient with a chronic perforation of the tympanic membrane undergoes surgery may help to determine the potential results of tympanoplasty. Holmquiest[9] studied eustachian tube function in adults before and after tympanoplasty and reported that the operation had a high rate of success when a function of the eustachian tube was good. However in patients without good tube function surgery frequently failed to close the perforation[10]. Some investigators found no correlation between the results of the inflation and deflation test and success or failure of tympanoplasty[11]. Manning et al[12] reported that good eustachian tube function was predictive of a good outcome but that poor tube function was not helpful in predicting a poor outcome. Kumazawa et al[13] consider preoperative evaluation using eustachian tube function tests to be helpful in prognosis.

The present study showed that in ICW mastoidectomy there is significant difference in average audiological gain between patients with patent eustachian tube and those with blocked (p=0.022, t=2.63). While no significant difference is seen in graft uptake (p=0.629). These results are favoring the reports of Holmquiest,[9] who found better results when the eustachian tube was patent.

In CWD mastoidectomy with tympanoplasty, there is no significant difference in average audiological gain (t=1.73, p>0.05) and graft uptake (p=0.711) between patients with patent eustachian tube and those with blocked eustachian tube. These results are similar to those of Anderson and harris[11], and virtianen et al [14] who reported that no correlation between the results of the inflation and deflation test and success or failure of tympanoplasty.

Conclusion

The management of the unsafe type of chronic suppurative otitis media is a surgical endeavor with the primary aim of eradication of disease and making the ear dry and safe. Though ICW mastoidectomy with tympanoplasty may need a revision surgery due to recurrence in some cases, the results

of postoperative audiological gain in regards to the patency of eustachian tube are better.

References

1. Abramson M, Huang C. Localization of collagenase in human middle ear cholesteatoma. Laryngoscope 1977; 87:777-85.
2. Tos M, Lau T. Attic cholesteatoma: recurrence rate related to observation time. Am J. Otol 1988; 9:456-64.
3. Merchant SN, Ravicz ME, Voss SE, et al. Toynbee Memorial Lecture 1997. Middle ear mechanics in normal, diseased and reconstructed ears. J Laryngol Otol 1998; 112:715–31.
4. Rosowski JJ, Merchant SN. Mechanical and acoustic analysis of middle-ear reconstruction. Am J Otol 1995; 16:486–97.
5. Goodey RJ, Smyth G.D. Combined approach tympanoplasty in children. Laryngoscope 1970; 82:166-171.
6. Paparella M, Morris MS, da Costa SS. A one stage compromise of the open vs. closed method – the IBMC intact-bridge tympano mastoidectomy procedure. In: Tos M, Thomsen J, Petersen E, editors. Cholesteatoma and mastoid surgery. Amsterdam: Kugler & Ghedini; 1989. p. 885-92.
7. Ragheb S, Gantz B, McCabe B. Hearing results after cholesteatoma surgery: the Iowa experience. Laryngoscope1987;97: 1254-63.
8. Karmarkar S, Bhatia S, Saleh E, De Donato G, Taibah AK, Russo A, et al. Cholesteatoma surgery: the individualized technique. Ann Otol Rhinol Laryngol 1995; 104:591-5.
9. Holmquist i. the role of eustachian tube in the myringoplasty. Acta Otolaryngol 1968; 66:289.
10. Miller gf jr, bilodeau r. preoperative evaluation of eustachian tube functions in tympanoplasty. South med j 1967; 60:868.
11. Andreasson I, harris s. middle ear mechanics, and eustachian tube function in tympanoplasty. Acta otolaryngol (suppl) 1979; 360:141.
12. Manning SC, Cantekin EI, Kenna MA et al. prognostic value of eustachian tube functions in pediatric tympanoplasty. Laryngoscope 1987; 97:1012.
13. Kumazawa T, Iwan T, Ushiro K et al. tubotympanoplasty. Acta otolaryngol (suppl)1993; 500:14.
14. Vertianen E. Karjalainen S. and Karja J. Postoperative evaluation of chronic otitis media caused by pseudomonas aeruginosa. The Jr. of Laryngology and Otology 1986; 100:141-144.

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