Anatomical and Hearing Outcomes of Endoscopic Assisted Atticotomy with Cartilage Tympanoplasty in Cases of Limited Mastoid Disease

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Abstract

Objective: To study the anatomical and hearing outcomes in endoscopic assisted atticotomy with cartilage tympanoplasty in patients with limited mastoid disease (involving attic, antrum).

Material and methods: Study was conducted in a tertiary care referral hospital between July 2012 and April 2015. Total 28 patients with limited mastoid diseases were included in the study. All underwent endoscopic assisted atticotomy and cartilage tympanoplasty. Patients were evaluated at 3 months, 6 months and 12 months after surgery to assess the graft uptake and hearing outcome. In postoperative period, ≥10 dB closure of air bone gap was considered significant improvement in hearing.

Result: Of 28 patients, cholesteatoma involving attic was found in 13(45%) patients, posteriorsuperior mesotympanum in 7(25%) patients and 8(30%) patients presented with attic retraction. Out of 28 patients, 8(28.57%) were undergone type I tympanoplasty, 16(57.14%) were undergone type IIIB tympanoplasty and 4(14.28%) were undergone type IIIC tympanoplasty. The mean AB closure were 11.13 dB, 9.56 dB, and 8.0 dB in type I, type IIIB and type IIIC cartilage tympanoplasty respectively after 12 months. 75% of patients with type 1 tympanoplasty, 6(37.50%) patients with type IIIB tympanoplasty showed significant improvement in hearing (≥10.00 dB). 2 patients had residual perforation after 3 months of surgery and none of them had postoperative retraction.

Conclusion: Atticotomy supplemented with otoendoscopy is an effective surgical technique for the management of limited mastoid disease and autologous conchal cartilage is an ideal autograft considered for the reconstruction of the attic and for cartilage tympanoplasty associated with satisfactory outcomes.

ABBREVIATIONS

CWD: Canal Wall Down; ICW: Intact Canal Wall; AAO-HNS: American Academy of Otolaryngology-Head And Neck Surgery; ABG: Air-Bone Gap

INTRODUCTION

Cholesteatoma in the attic can traverse in medial or lateral to involve the ossicles and can cause complications [1]. There are different surgical modalities of treatment have been recommended in the past to treat the cholesteatoma aimed at complete clearance of the disease, restoration of hearing and to prevent the residual or recurrent cholesteatoma. Both canal wall down (CWD) and intact canal wall (ICW) mastoidectomies are the primary surgical procedures subjected to the patients of attic cholesteatoma. Though CWD approach can give wide exposure for the removal of disease but it is not free from cavity problems. Again in ICW technique, though the cavity problems can be avoided, but there is high chance of residual and recurrent diseases and it is difficult to access the anterior epitympanic space and subsequently May requires complete CWD mastoidectomy for residual or recurrent disease [2]. To overcome these above drawbacks, atticotomy is often tried as an alternate surgical technique in patients with limited mastoid cholesteatoma.
Although complete clearance of disease is ensured from anterior epitympanic space, it is very difficult to assess the sinus tympani area because of inadequate of exposure by direct vision under microscope. With the advancement of endoscopic sinus surgery in the past decades, otoscopes (3 mm rigid angled 30˚, 70˚) are often used in the otological surgery and it has been possible to inspect the sinus tympani and antrum for complete removal of disease without removal of posterior bony canal wall. In the present study, we have described the anatomical and hearing outcomes in 28 patients with limited mastoid disease (disease involving attic and antrum, confirmed by CT scan) who have undergone atticotomy with cartilage tympanoplasty with the aid of otoendoscopes.

MATERIALS AND METHODS

It was a prospective study, conducted in a tertiary care referral hospital between July 2012 and April 2015. Total 28 patients with limited mastoid disease (cholesteatoma involving attic/antrum or posterior mesotympanum/attic retraction pocket) with conductive hearing loss were included in the study. After otoscopic examination, all patients were advised for high resolution CT scan to confirm the extension of cholesteatoma and to assess the ossicular status prior to the surgery. Cholesteatoma extended beyond antrum or causing complications were excluded from the study. Pure tone audiometry (PTA) was done in each patient prior to operation. After informed written consent, all patients underwent atticotomy with tympanoplasty.

SURGICAL PROCEDURE

All surgeries were performed by a single surgeon through postauricular approach under general anesthesia. Circumferential tympanomeatal flap was elevated clockwise 270˚ from 6 ‘o’ clock to 3 ‘o’ clock position. Epitympanum and the mesotympanum were visualized. Drilling was started with canaloplasty to remove the bony overhang. Then lateral epitympanic wall was drilled out completely to make a wide opening into the attic and the whole extent of cholesteatoma was visualized. When cholesteatoma sac was found extending lateral to ossicles (malleus and incus), disease was removed carefully with preservation of the ossicles. And when it was extended medially, ossicles were removed for the complete clearance of disease. 3 mm, 30˚ rigid otoscope was used to inspect and to dear the disease from whole attic, antrum and sinus tympani under direct visualization. Tympanoplasty was performed depending upon the ossicular status. Patients with intact ossicular chain have undergone type I cartilage palisade tympanoplasty. A large piece of conchal cartilage was harvested with its perichondrium and one side of the perichondrium was removed. A small piece of it was used for the reconstruction of attic defect and rest of the cartilage was cut into full thickness cartilage strips according to the shape and size of the tympanic membrane. One strip was put anterior to handle of malleus proceeding forward to secure against the lateral wall of the eustachian tube, one was placed posterior to handle of malleus and a small piece was placed in between them. Whole cartilage assembly was snugly fitted at the level of manubrium and supported medially by gel foams, laterally by perichondrium. No space was allowed between the posterior canal wall and the reconstructed tympanic membrane.

When incus was found eroded with intact steps superstructure, the former was removed and the cartilage strip which was placed behind the handle of malleus was ensured to have close contact over the steps head (Type III B tympanoplasty). When the steps superstructure was found absent with or without erosion of incus, then a small piece of conchal cartilage was placed over the steps foot plate laterally supported by the cartilage assembly (Type III C tympanoplasty). The tympanomeatal flap was then repositioned back and external auditory channel was packed with medicated wick.

Follow up

Patients were discharged after 24 hours of surgery with a course of systemic antibiotics for 1 week and were called after 7 days for removal of stitch and the pack from external auditory canal. Patients were allowed to visit the outpatient otologic clinic at 3 months, 6 months and 12 months of surgery. Otomicroscopic examination was performed at each follow-up visit to look for complications associated with the procedure. Pure tone audiometry (PTA) was done at each follow-up visit. Preoperative and postoperative hearing results were reported according to the guidelines of conductive hearing loss recommended by the Committee on Hearing and Equilibrium of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) [3]. Air and bone conduction thresholds values were measured at 500, 1,000, 2,000, and 3,000 Hz and the air-bone gap (ABG) were calculated. The preoperative and worst postoperative audiograms were compared after 12 months of surgery and difference of ≥10 dB closure of A-B gap was considered significant.

RESULTS

Of 28 patients, 18(64.28%) were males and 10(35.72%) were females. Of them, attic cholesteatoma was found in 13(45%) patients, 7(25%) patients presented with cholesteatoma in posteriorsuperior mesotympanum and 8(30%) patients presented with retraction pocket in attic where fundus was not visible. All patients were presented with either atelectatic or retracted of pars tensa (grade III/IV) with conductive deafness. The results have been described in Table 1. Of the 13 patients, 2 patients underwent type I tympanoplasty, 8 patients with type IIIB tympanoplasty and 3 patients with type IIC

| Description of results in the study population. |
|---|---|---|---|
| Total (n=28) | Male/Female 18:10 Type I Type III B Type III C |
| Attic cholesteatoma (n) | 02 08 | 03 |
| PSRP with cholesteatoma (n) | 01 05 | 01 |
| Attic retraction pocket (n) | 05 03 | 00 |
| Tympanoplasty (n= 28) (n) | 8(28.57%) 16(57.15%) 4(14.28%) |

Hearing outcomes (PTA)

<table>
<thead>
<tr>
<th>Preoperative (dB)</th>
<th>Postoperative (dB)</th>
<th>Mean ABG closure (dB)</th>
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<tr>
<td>31.25 ± 6.79 34.93 ± 8.2</td>
<td>20.12 ± 3.40 25.37 ± 7.89</td>
<td>11.13 9.56</td>
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| Abbreviations: ABG: Air Bone Gap; PTA: Pure Tone Audiogram; PSRP: Posterosuperior Retraction Pocket |
tympanoplasty. Of 7 patients with posterortsuperior retraction pocket with cholesteatoma, Type I tympanoplasty was done in 1 patient, type IIIB tympanoplasty in 3 patients and type IIIC tympanoplasty was carried out in 1 patient. Similarly of 8 patients with attic retraction, 5(62.50%) of patients underwent type I tympanoplasty and 3(37.50%) of patients have undergone type IIIB tympanoplasty. Of total 28 patients, 8(28.57%) have undergone type I tympanoplasty, the mean preoperative and postoperative hearing thresholds were 31.25±6.79 and 20.12±3.40 respectively with mean A-B closure of 11.13dB. 6 (75%) patients were found to have significant improvement in hearing (≥10 dB closure of A-B gap). Of 16 patients undergoing type IIIB tympanoplasty, the mean preoperative and postoperative hearing threshold were 34.93±8.2dB and 25.37±7.89 dB respectively in with 9.56 dB AB closure and of which only 6 (37.50%) patients presented with ≥10.0dB closure of A-B gap. Of 4 patients undergoing type IIIC cartilage tympanoplasty, the mean preoperative and postoperative hearing threshold was 38.50 ± 8.30 dB and postoperative hearing level was 30.50±5.31dB with 8.0 dB mean closure of A-B gap and none of the patient had significant improvement in hearing (≥10dB air bone gap).

In 2 patients, facial nerve was found to be exposed at second genus due to the erosion of fallopian canal by cholesteatoma and there was no facial palsy noted in the postoperative period. 2 patients had small residual perforation due to displacement of one cartilage strip in the middle ear, noticed after 3 months of surgery and one of them was healed after 6 months of surgery and the other underwent revision cartilage tympanoplasty. None
of the patient was found with retraction of the pars tensa or attic and there was no recurrence of the disease noted till 12 months of follow-up.

**DISCUSSION**

As attic is a small three dimensional spaces overcrowded with important anatomical structures, hence there is higher chance of residual cholesteatoma compared to the canal wall down procedures. Again it is difficult to inspect the hidden areas of the middle ear cleft under direct vision through otomicroscope. Uyar et al [3] have reported 4.8% of recurrence of cholesteatoma among 83 patients undergoing microscopic atticotomy. With the advancement of angled otoendoscopes (3 mm 30° and 70° degree rigid otoendoscopes) in the field of otology, it has become possible to inspect epitympanum, antrum, and sinus tympani for complete removal of disease. Rehl RM et al [4] conducted a cadaveric study by using the rigid otoendoscopes for tympanomastoïdectomies described better visualization of the sinus tympani area compared to the CWD mastoidectomies. Previous studies have also described the use of rigid angled otoendoscopes in the field of otology for complete clearance of disease from the hidden areas of the middle ear cleft aimed at decreasing the incidence of residual cholesteatoma [5-8]. Because of wide angle view of the modern otoendoscopes, it has been possible to access the deep epitympanic recess without removal of lateral wall with preservation of ossicles [9-11]. Again Ghaffar S et al [12], by using pediatric rigid otoendoscopes for tympanoplasty concluded that there is a definite role of otoendoscopes in middle ear surgery which may not even require lowering the scutum. Ajalloueyan [13] also reported that the use of otoendoscopes in Otomicroscopic surgery has decreased the recurrence rate of the disease along with improvement in postoperative hearing. Similar to the above studies, microscopic atticotomy assisted by otoendoscopes as described in our present study is found to have encouraging results i.e none of the patients had recurrent disease at the end of 12 months of follow-up which was also supported by Ji Heui Kim, et al [14].

The final graft uptake rate was 92.85% and only 2 patients had residual perforation of 28 patients. Looking in to the literature, different studies showed the similar results. Neumann et al. [15] Uzun et al [16]. Anderson et al [17] have found encouraging postoperative results by using cartilage graft for type I tympanoplasty concluded that cartilage being rigid can withstand the negative middle ear pressure particularly in patient with retracted tympanic membrane. There are very few reports found in the literature describing the anatomical and functional outcome of autologous cartilage type III tympanoplasty. Bernal-Sprekelson M et al [18] conducted a study by using autologous cartilage graft for type III tympanoplasty demonstrated closure of tympanic membrane in 98.3% of cases and significant improvement in hearing (>10dB) in 32.3% cases with the recurrence rate of (2.2%) after 36 months of surgery. In the present study, the mean AB closure were 11.13 dB, 9.56 dB, and 8.0 dB in type I, type IIIB and type IIIC cartilage tympanoplasty respectively after 12 months of follow-up. Though hearing was found to be improved in each group, patients with Type I tympanoplasty showed better hearing improvement i.e. 75% of the patients showed significant improvement in hearing (≥10.00 dB). Again of total 16 patients undergoing type IIIB tympanoplasty, 6(37.50%) patients had ≥10.00 dB improvement in hearing and in the rest no significant improvement was noticed. None of the patients in type IIIC tympanoplasty was found to have significant improvement in hearing, may be because of absent of steps superstructure. Although variable hearing outcomes were noticed depending upon the ossicular status, atticotomy with cartilage tympanoplasty assisted with otoendoscope provides a dry, safe and disease free ear probably because of complete clearance of disease under direct vision.

**CONCLUSION**

Atticotomy is an effective technique for management of limited mastoid disease. Otoendoscopes can be supplemented to routine microscopic procedure for inspection of hidden areas of middle ear cleft to ensure complete clearance of disease with minimal drilling of posterior canal wall. Autologous conchal cartilage can be used both for attic reconstruction and tympanic membrane grafting with satisfactory outcomes. Though significant improvement in hearing was noticed in 75% of patients with type I cartilage tympanoplasty and 31.25% with type IIIB tympanoplasty, all patients have dry and safe and disease free ear even after 12 months of surgery.

**REFERENCES**


