

Exploratory Tympanotomy For Conductive Hearing Loss with Intact Tympanic Membrane: What To Expect Intraoperatively?

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Abstract:

Background: Exploratory tympanotomy is done to identify the cause of conductive hearing loss in a patient with intact tympanic membrane.

Objective: To enlist and analyze the middle ear pathologies in patients with conductive hearing loss with intact tympanic membrane.

Methods: 50 patients in age group between 20 years and 50 years, with hard of hearing, consulting department of ENT at a tertiary care hospital, were evaluated. Clinical examination, pure tone audiometry and tympanometry were done for all patients. Patients with conductive hearing loss with intact tympanic membrane were taken up for exploratory tympanotomy.

Results: Most common middle ear pathology in the study was otosclerosis. Differential diagnoses for clinical and audiological findings suggestive of otosclerosis were anatomical abnormalities of ossicles & restricted ossicular mobility. Other middle ear causes for conductive hearing loss were ossicular necrosis and adhesive otitis media. Tympanic membrane abnormalities in the form of thin tympanic membrane, retracted tympanic membrane and myringosclerosis were found to be associated with conductive hearing loss in the absence of any middle ear cause. Patients with history suggestive of healed chronic middle ear infection were found to have more probability of middle ear sequelae in the form of middle ear adhesions, tympanosclerotic patches over the ossicular joints resulting in restricted ossicular mobility and ossicular necrosis.

Conclusion: The study provides an insight into different causes of conductive hearing loss behind an intact tympanic membrane and illustrates few instances where abnormal middle ear anatomy interferes with surgical correction of conductive hearing loss.

Keywords: exploratory tympanotomy, tympanosclerosis, ossicular necrosis, adhesive bands, an omalous facial canal

I. Introduction

In spite of the advances we have witnessed in technology in recent times, it is often difficult to establish with confidence a preoperative diagnosis in a patient of conductive hearing loss with intact tympanic membrane. Otolaryngologists frequently resort to exploratory tympanotomy in order to establish a diagnosis & also for surgical treatment. The etiology of conductive hearing loss with intact tympanic membrane includes otosclerosis, ossicular chain fixation, discontinuity, adhesion etc. Sometimes additional findings can be encountered during exploratory tympanotomy which are of doubtful significance or which may hinder the correction of the cause of conductive hearing loss.

II. Methodology

Objective: To enlist and analyze the middle ear pathologies in patients of conductive hearing loss with intact tympanic membrane.

Source Of Data: Patients attending Otorhinolaryngology Outpatient department in a tertiary care hospital who were subjected to exploratory tympanotomy for conductive hearing loss with intact tympanic membrane, from January 2013 to November 2016.

Inclusion Criteria

- a) Patients with purely conductive hearing loss with intact tympanic membrane
- b) Patients with mixed hearing loss with Air Bone gap of

>20 dB with intact tympanic membrane

Exclusion Criteria

- a) Acute middle ear conditions (infective, inflammatory)
- b) Previous history of ear surgery

Study Design: Prospective study.

50 patients between 20 years and 50 years of age, with hard of hearing, consulting department of ENT at SSIMS & RC were evaluated. Clinical examination, pure tone audiometry and tympanometry were done for all patients. Patients with conductive hearing loss with intact tympanic membrane were taken up for exploratory tympanotomy after obtaining informed written consent.

Surgery was done under microscopic guidance using Carl Zeiss surgical microscope. Transcanal approach was used. Postaural approach was adopted in case of narrow ear canal or canal with bony overhang. Middle ear findings with respect to ossicular anatomy, mobility, status of middle ear mucosa and evidence of any additional findings were recorded. Appropriate surgical intervention was done in necessary cases.

III. Results

Out of the 50 patients, 58% (29 patients) were males and 42% (21 patients) were females. Majority of the patients (42%) were in the age group of 20-30 years. Majority of patients, 82% (41 patients) presented with hearing loss for 1-5 years. 8 patients had it for less than 1 year and 1 patient for more than 5 years.

19 patients (38%) complained of unilateral hearing loss whereas 31 patients (62%) had bilateral hearing loss. Hearing loss was progressive in 25 patients (50%) and non-progressive in 25 (50%) patients. 58% (29 patients) had tinnitus associated with hearing loss. History of trauma was present in 1 patient. But there was no evidence of ossicular discontinuity on tympanotomy.

On clinical examination, 27 patients (54%) had an absolutely normal and intact tympanic membrane. 20 patients (40%) had retracted tympanic membrane and 2 patients had thin tympanic membrane. 1 patient had myringosclerosis.

Pure tone audiometry revealed conductive hearing loss for 41 patients (82%) and mixed hearing loss with air bone gap >20 dB in 9 patients (18%). Impedance audiometry revealed As type of curve in 25 patients (50%) of patients, A type in 15 patients (30%), Ad in 1 patient (2%), B in 3 patients (6%), C type in 6 patients (12%).

Exploratory tympanotomy revealed following findings-

Tympanotomy finding	No. of cases
Otosclerosis	24
Restricted ossicular mobility	10
Bony anomaly in middle ear	1
Ossicular necrosis	4
Normal middle ear	11

Otosclerosis

The most common intraoperative finding was otosclerotic foci at the footplate of stapes affecting mobility of stapes. This was seen in 48% (24 cases) of patients. Out of the total 24 cases, 13 were male (54.16%) and 11 (45.83%) were female. Audiological evaluation revealed conductive hearing loss in 75% (18 cases) and 25% (6 patients) had mixed hearing loss with air- bone gap of more than 20 dB.

Intraoperatively, out of these 24 cases, 21 cases had purely otosclerotic findings. For these stapedotomy was done and piston of adequate size was placed. 3 cases had additional findings. 1 patient had a very thin stapes. For this patient removal of the thin stapes suprastructure and stapedotomy with teflon prosthesis placement was done. Other 2 patients had anomalous facial canal which resulted in abandoning the surgery because of risk of facial nerve palsy at attempted stapes surgery. For both these patients postoperative counselling was done and hearing aid was advised.

Restricted Ossicular Mobility

20% (10 cases) had restricted ossicular mobility. Out of these 2 cases (20%) had a shield like stapes with posterior crura fixed to promontory which restricted stapes mobility. Mobilization of stapes was done. 2 cases had whitish plaque extending from incus to posterior wall of middle ear which was removed. These patients had clinical and audiological findings suggestive of otosclerosis. These patients had postoperative symptomatic hearing improvement.

1 case was a 22 year old male patient with clinical appearance suggestive of mild form of Treacher-Collins anomaly. He had hypoplastic zygomatic bones and mandible, low set pinna, with 2 preauricular sinuses.

He had bilateral moderate non-progressive conductive hearing loss with B type curve. He had history of ear discharge 6 months back and a retracted tympanic membrane on examination. Intraoperatively, adhesive bands were found in the middle ear attached to the incus with malleus erosion. There was no facial nerve anomaly. Adhesive bands were released in this case which revealed symptomatic hearing improvement.



Picture 9 : Treacher- Collins syndrome

Another case had adhesive bands in the middle ear with partially necrosed malleus with symptomatic hearing improvement following band lysis. Isolated tympanosclerosis over ossicles causing conductive hearing loss was found in 3 cases. Intraoperatively hypertrophied middle ear mucosa was found with tympanosclerotic patches over the ossicular chain and no evidence of cholesteatoma or granulation tissue was there. One patient had incudomalloleolar and incudostapedial joint fixity. Joints were mobilized and tragalperichondrial graft was wrapped around the incudostapedial joint intraoperatively which revealed significant symptomatic hearing improvement in immediate postoperative period.

Ossicular Necrosis

Ossicular necrosis was found in 8% (4 cases). Two patients had isolated incus erosion. One patient had clinically bilateral serous otitis media with adhesive otitis media on the proposed side of exploration. 2nd patient also had ipsilateral adhesive otitis media. 3rd patient had adhesive otitis media on the same side with retraction pockets in the attic and squamous debris over the tympanic membrane. Intraoperatively, thick glue like material could be aspirated from middle ear. Long process of incus and stapes head was found to be necrosed. 4th patient had adhesive otitis media with extensive tympanosclerosis in the middle ear encasing the malleus and the incus and over the promontory. Malleus was partly mobile and stapes was mobile, but adhesions were found between the middle ear mucosa and the stapes.

Abnormal Bone In Middle Ear

One patient had unilateral non progressive moderately severe conductive hearing loss. Intraoperatively, an abnormal band of bone was found along chorda tympani nerve, medial to incus. Malleus was found to be deformed in this case. Surgery was abandoned and an HRCT temporal bone was done to rule out the possibility of any associated facial canal anomaly. HRCT showed no obvious anomalies but the patient was not willing for a second surgery. So he was kept under regular follow up which revealed no progression of hearing loss.



Picture 13: Abnormal band of bone in middle ear

Normal middle ear

Middle ear was found to be normal in 11 cases (22%) inspite of clinical and audiological conductive hearing loss. Thin tympanic membrane with posterosuperior retraction pocket containing squamous flakes was found in 1 patient. Posterosuperior bony erosion was present but middle ear was found to be normal.

IV. Discussion

This study was conducted with the aim of analysing the middle ear status in patients of conductive hearing loss with an intact tympanic membrane.

Otosclerosis was found to be the most common cause of conductive hearing loss in the presence of intact tympanic membrane (48% of cases). Kim S H et al. reviewed the medical records of 365 patients with intact TM, who underwent exploratory tympanotomy for conductive hearing loss and found that exploration was performed most frequently in the second and fifth decades. The most common diagnosis was stapedial fixation with non-progressive hearing loss.² This was again established in this study, with 48% of the patients having otosclerosis as the cause of the conductive hearing loss behind an intact tympanic membrane.

Second most common finding was restricted ossicular mobility due to middle ear pathologies like tympanosclerosis at ossicular joints, middle ear adhesions, structural and positional anomalies and ossicular joint fixity affecting 20 % cases. Out of these, 50% cases had tympanosclerosis causing fixity of ossicular chain. In a study by Asarkar A, Gosavi S (2013) the commonest presenting symptom of tympanosclerosis was hearing impairment in 72.6% cases with conductive loss being the commonest in 85% of varying degree³. Pal et al. in their series had found that about 60% of their cases had deafness as their presenting symptom of which 83.3% had a conductive loss⁴. The impairment of hearing was due to involvement of middle ear conductive system due to the inflammatory process leading to tympanosclerosis (Sorensen & True, 1978).³

The clinical association of tympanosclerosis and a dry ear has been reported by various authors -Sheehy and House (1962) - 91% dry ears in a study of 75 cases, Austin (1988) - 92% dry ears in a study of 320 cases and Asiri et al (1999) - 86% dry ears in a study of 90 cases of tympanosclerosis. However, Emmett & Shea (1978) reported only 53%, dry ears in a study of 45 cases of tympanosclerosis and Kinney (1978) reported only 63% dry ears in a study of 132 cases of tympanosclerosis. The association of dry ears and tympanosclerosis can be explained by the fact that tympanosclerosis is a pathological condition which is morphologically and dynamically exhausted as it is the irreversible end-result of previous middle-ear inflammation. It is a post otorrhoeic sequel, regardless of the kind of otorrhea which characterized the ear inflammation.⁵ In our study, 3 out of 5 patients had history of ear discharge in the past with intact tympanic membrane at the time of study which shows 60% association with chronic middle ear disease.

In our study, incidence of ossicular anomalies causing restricted ossicular mobility was found in 20% cases. All cases had stapes anomaly. Hung K L reported regarding seventeen cases of ears that underwent exploratory tympanotomy and found that stapes was the most frequently involved ossicle. Six patients (35.3%) had isolated stapes anomalies, 8 (47%) had incus and stapes anomalies, and all of the remaining patients had anomalies in all 3 ossicles.⁶

Middle ear abnormalities occur in approximately 20%– 25% as a part of a malformation syndrome of which Treacher Collins Syndrome is one of the most frequently diagnosed. The most common HRCT findings in patients with TCS are narrow epitympanum, abnormalities of the ossicular chain, abnormal course of the facial nerve, and absence of mastoid pneumatization, which is a rather constant finding (2/3 of all ears).⁷ In our study, 1 patient had clinical features suggestive of Treacher Collins syndrome with adhesive bands were found in the middle ear attached to the incus with malleus erosion. These findings can be attributed to his history of chronic middle ear inflammation rather than part of his suspected syndrome.

Malleus ankylosis is a cause of conductive hearing loss that can be difficult to assess, particularly in association with otosclerotic stapes fixation.⁸ In our study, 1 patient had incudomalleolar and incudostapedial joint fixity. 22% cases of malleus cases are reported to be bilateral. 80 % cases had normal tympanic membrane according to Vincent Robert et al.⁸

8 % had ossicular necrosis. All cases (100%) of ossicular necrosis were associated with adhesive otitis media. Long process of incus was found to be more commonly affected⁹ and this can be attributed to its poor blood supply with the result of a natural myringostapediopexy. The stapes is the second most commonly involved ossicle.⁹ Stapes erosion is seen in 25% of cases according to literature¹⁰ and exact 25% of our cases had stapes erosion. The ossicles may become fixed by fibrous tissue secondary to adhesive otitis media.⁹

One patient had an abnormal band of bone was found along chorda tympani nerve, medial to incus. Malleus was found to be deformed in this case. Patient had unilateral non progressive moderately severe conductive hearing loss. This anomaly has not been reported in literatures.

Despite thorough radiological evaluation or surgical exploration, no external or middle ear problems are detected in some patients. Bess et al reported 3 patients who had a conductive hearing loss with a normal middle ear system¹¹, and Schuknecht¹² dubbed these unexplained cases “otologic mysteries” which can occur at a rate of

1 in 3000 procedures. Since Ranke et al proposed “the third window” in 1952, there have been several attempts to explain the conductive component in patients who had only inner ear anomalies such as enlarged vestibular aqueduct (EVA), without any external or middle ear abnormalities by this theory. An EVA can serve as a third window; it can shunt the acoustic energy away from the cochlear partition and increase air conduction thresholds. In addition, any inner ear anomalies, which can connect the inner ear fluid space and the cranial cavity, can also Kim and Wilson¹³ also reported conductive hearing loss even in a patient with carotid canal dehiscence.

Bess et al found pathologic third windows to be a potential cause of conductive hearing loss in 20% of patients who fail to obtain hearing gains after exploratory tympanotomy and ossiculoplasty. Their data suggest that conductive hearing loss originating from anatomical inner ear problems could be the main reason for failure of ossiculoplasty. Therefore, surgeons must carefully review the temporal bone CT to find inner ear anomalies before exploratory tympanotomy.¹¹

V. Conclusion

This study is a clinical prospective study of 50 patients who underwent exploratory tympanotomy in a tertiary care referral hospital to find out the cause for conductive hearing loss.

The analysis revealed the following-

1. Conductive hearing loss with intact tympanic membrane was most commonly found in young adult males. Tinnitus was found to be the most common symptom associated with conductive hearing loss. Most common middle ear pathology in the study was otosclerosis.
2. Other differential diagnosis for clinical and audiological findings suggestive of otosclerosis were
 - Anatomical abnormalities of ossicles, stapes being most common
 - Restricted ossicular mobility
 - Stapes attached to promontory
 - Incudomalleolar joint fixity
 - Plaques attaching ossicles to posterior wall of middle ear, more commonly found with incus.
3. Other middle ear causes for conductive hearing loss were restricted ossicular mobility, ossicular necrosis and adhesive otitis media. Causes for restricted ossicular mobility included structural and functional abnormalities of ossicles, tympanosclerosis around ossicular joints, joint fixity and middle ear mucosal adhesions. Out of these, tympanosclerosis around joints was found to be the most common cause.
4. In ossicular necrosis cases, adhesive otitis media was found to be a universal association which can be considered as a possible etiology for the same. Long process of incus was the most commonly eroded bone.
5. Factors which can interfere with analysis or correction of middle ear conductive pathology include abnormal bony abnormalities in relation to the facial canal or abnormalities of facial nerve itself.
6. In spite of a proper middle ear examination, in few cases cause of conductive hearing loss couldn't be found out. In such cases surgeons must carefully review the temporal bone CT to find inner ear anomalies.
7. Even tympanic membrane abnormalities in the form of thin tympanic membrane, retracted tympanic membrane and myringosclerosis were found to be associated with conductive hearing loss in the absence of any middle ear cause.

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