

CORRELATION OF OSSICULAR CHAIN DEFECTS WITH AUDIOMETRIC PROFILE IN PATIENTS WITH CHRONIC SUPPURATIVE OTITIS MEDIA SQUAMOUS EPITHELIAL TYPE

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ABSTRACT

BACKGROUND

Chronic suppurative otitis media (CSOM) is a common disease seen in otolaryngology practice. Two clinical types are seen, squamous epithelial and mucosal. The squamous epithelial type is associated with cholesteatoma in the tympanomastoid area. Cholesteatoma has bone eroding properties. This can result in erosion of bony plates surrounding the middle ear and mastoid leading to life-threatening complications. The propensity of ossicular destruction is also higher in patients with cholesteatoma. Pure tone audiometry is used to establish the type and severity of hearing loss. The degree of hearing loss worsens with increased destruction of the tympanic membrane and ossicular chain.

Hence, the objective of this study is to evaluate the relationship of ossicular chain defects with the degree of hearing loss in patients with CSOM squamous epithelial type.

MATERIALS AND METHODS

This is a prospective study conducted from 1st November 2016 to 30th April 2017 on 102 patients, who had CSOM squamous epithelial type. These patients were selected randomly and were examined using otoendoscopy, microscopy and pure tone audiometry preoperatively. During surgery tympanic membrane pathology, ossicular chain status and disease in the middle ear like cholesteatoma and granulations were recorded and analysed.

RESULTS

Majority of patients ranged between 21 to 30 years with male: female ratio being 1.6: 1. Epitympanic cholesteatoma was the commonest finding. The most frequently eroded ossicle was the Incus (94.1%) with Stapes being eroded in 47.1% of patients. The Malleus was the most resilient ossicle and was eroded in 32.4%. Type A defect was commonest and hearing loss was highest for type D defect with a pure tone average (PTA) of 55.83 db and average air bone gap (ABG) of 39.68 db.

CONCLUSION

This study defines the status of individual ossicles with the degree of hearing loss in patients with CSOM squamous epithelial type. Malleus was found to be the most resistant ossicle to erosion, whereas the Incus was the most susceptible. Pure tone audiometry gives a broad perspective about the ossicular status and serviceable hearing that can be attained postoperatively.

KEYWORDS

Chronic Suppurative Otitis Media, Cholesteatoma, Ossicles, Pure Tone Audiometry.

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BACKGROUND

CSOM is an important middle ear disease since prehistoric times. It is a worldwide health problem and is still prevalent in the modern antibiotic era. Prevalence of CSOM in developing countries represent a wide range of 0.4% to 33.3%. In India, the prevalence rate of CSOM is 7.8% according to surveys conducted by the World Health Organisation.¹

CSOM squamous epithelial type is characterised by a permanent perforation and persistent ear discharge refractory to topical antibiotics. The hallmark of this disease is the presence of a tumour-like mass called cholesteatoma,

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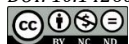
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which has bone destroying properties. It involves the middle ear and mastoid and adjacent bony structures like the delicate ossicles. The middle ear mucosal folds and ligaments direct the growth and spread of cholesteatoma as follows-

1. Epitympanic (Attic) cholesteatomas arise in the pars flaccida and grow upwards towards the epitympanum. These may be subdivided into lateral epitympanic cholesteatomas if they involve only the Prussak's space, posterior epitympanic cholesteatomas if they grow medial to the incus to involve the posterior epitympanic space, anterior epitympanic cholesteatoma if they grow anteriorly to fill the space anterior to the cog.
2. Mesotympanic (Middle ear) cholesteatomas arise from the pars tensa and grow medially towards the long process of incus and stapes suprastructure. They may then grow upwards towards the posterior epitympanum or backwards into the facial recess and sinus tympani.
3. Holotympanic cholesteatomas involve the middle ear, epitympanum and mastoid.

4. Congenital cholesteatomas begin in the middle ear, usually in the antero-superior quadrant and may grow in all directions.²

Bone erosion is an established pathological characteristic of cholesteatoma. The mechanism of bone destruction is widely debated. It was initially believed that bone destruction was due to chronic gradual pressure exerted by the cholesteatoma. Some workers believe that a chemical process is responsible for bone destruction.

According to data obtained by Raman Spectroscopy Ohsaki³ postulated that inorganic material in bone dissolves in otorrhea fluid, which has been rendered acidic due to fatty acids. This process is called demineralisation.

Interleukin-1 has been found in cholesteatoma by immune peroxidase and immunofluorescence technique. Interleukin-1 produces osteoclast activating factors, which stimulates osteoclasts which results in bone resorption. It also promotes migration of inflammatory cells and stimulates fibroblasts to produce prostaglandins and collagenase.⁴ Cholesteatoma also produces tumour necrosis factor alpha, which stimulates neovascularisation and hence granulation tissue formation.

Thomsen⁵ et al found little evidence of osteoclastic activity. They attributed bone resorption to histolytic activity within granulation tissue. CSOM squamous epithelial type is thus an inflammatory process with a defective wound healing mechanism. This inflammatory process in the middle ear is therefore harmful to the ossicular chain resulting in ossicular chain erosion and therefore discontinuity resulting in significant hearing loss.^{6,7} Hence, the objective of our study is to correlate ossicular chain defects with degree of hearing loss in patients with CSOM squamous epithelial type.

MATERIALS AND METHODS

This is a descriptive study conducted in the Department of ENT, Mysore Medical College and Research Institute, Mysore from 1st November 2016 to 30th April 2017 for a period of 6 months. The study involved 102 patients with CSOM squamous epithelial type. Consent for the study was taken from the Institutional Ethics Committee of our institution.

Aim of the Study

To correlate ossicular chain defects with degree of hearing loss in patients with CSOM squamous epithelial type.

Inclusion Criteria

Patients of both sexes aged between 10 - 60 years presenting with CSOM squamous epithelial type, active stage, who undergo tympanoplasty with mastoidectomy.

Exclusion Criteria

Patients who have undergone prior middle ear surgery, patients with inactive stage of the disease and patients with history of temporal bone trauma were excluded from the study.

A total of 102 patients of CSOM squamous epithelial type, active stage was randomly selected from the patients attending the ENT outpatient department. A detailed history was taken. All patients were subjected to a detailed examination which included a general physical examination, ENT and systemic examination. Otoscopy, otoendoscopy and

microscopic examination of the tympanic membrane and middle ear and tuning fork tests were performed. The tympanic membrane was inspected for pathology like attic and marginal perforations and retraction pockets. Tos' classification for epitympanic and Sade's classification for pars tensa retraction pockets was used. Granulations in attic or posterior margin of the tympanic membrane were looked for and studied. The middle ear mucosa through the perforation was evaluated for inflammatory changes. X-ray mastoid Schuller's view was taken. All the patients underwent a preoperative pure tone audiometry to assess the hearing status.

Audiometric assessment was performed using a clinical audiometer; Eymasa AD 100 audiometer calibrated according to International Organisation for Standardisation (ISO) 1964 specifications.

The patients hearing level in decibels were assessed. Mean air and bone conduction thresholds were determined at five frequencies 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. The mean air bone gap (ABG) was calculated. The air bone gap is a measure of the degree of conductive deafness. Hearing level was taken as the mean air conduction threshold at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. When evaluating correlation between middle ear pathology and hearing loss, we used the average air bone gap. From the air conduction threshold levels, the deafness can be graded into several categories according to the WHO classification (1980); normal hearing level (0 - 25 dB), mild (25 - 40 dB), moderate (41 - 55 dB), moderately severe (56 - 70 dB), severe (71 - 90 dB) and profound (> 90 dB). Hearing loss of patients were classified as conductive when bone conduction threshold is within normal levels and air conduction threshold is over 20 decibels (dB), sensorineural when air and bone conduction thresholds are over 20 dB and ABG is lower than 10 dB and mixed hearing loss when air conduction threshold is above 20 dB and ABG is larger than 10 dB.

All patients underwent a canal wall down mastoidectomy with tympanoplasty, intraoperatively the middle ear and mastoid pathology was assessed under the microscope and documented using a proforma sheet which was prepared earlier. The location and extent of cholesteatoma, ossicular defects and discontinuity, presence of granulation tissue in the middle ear and mastoid, polypoidal mucosa, tympanosclerosis and aditus patency was studied.

Austin Classification for Ossicular Defects was used to Classify Ossicular Defects-

- Type A= M+S+
- Type B= M+S-
- Type C= M-S+
- Type D= M-S-

The statistical analysis was done using statistical package for social sciences (SPSS version 12.0) for MS windows. Descriptive statistics such as mean and standard deviation for mean were determined using the ANOVA (Analysis Of Variance) test.

RESULTS

A total of 102 patients with CSOM squamous epithelial type were studied. The age of the patients ranged between 10 - 60

years, the majority belonging to 21 - 30 years (38.2%) with mean age being 26.9 years. There were 63 (61.8%) males and 39 (38.2%) females in the study. Of the 102 patients enrolled in the study, 42 (41.2%) patients underwent surgery on the right ear and 60 (58.8%) patients on left ear. Majority of the patients had conductive hearing loss (88.2%) and the rest had mixed hearing loss (11.8%). The mean pre-operative pure tone average was 45.80 dB and the average air bone gap was 33.39 dB.

Retraction Pockets

In our study, attic retraction pockets showed greater hearing loss with PTA of 49.96 +/- 12.86 dB and mean ABG of 35.43 +/- 8.31 dB, whereas in postero-superior retraction pockets the PTA was 42.89 +/- 9.28 dB and mean ABG was 31.96 +/- 9.69 dB (Table 1).

PTA	Retraction Pocket	Mean
	Attic	49.96 dB +/- 12.86
	Postero-superior	42.89 dB +/- 9.28
ABG	Attic	35.43 dB +/- 8.31
	Postero-superior	31.96 dB +/- 9.69

Table 1. Correlation of Location of Retraction Pockets with PTA and Mean ABG

Ossicular Erosion

The malleus was intact in 69 (67.6%) patients, handle of malleus was eroded in 21 (20.6%) patients and complete erosion of malleus was seen in 12 (11.8%) patients. Incus was intact in 6 (5.9%) patients, lenticular process erosion was observed in 3 (2.9%) patients, long process of incus was necrosed in 81 (79.4%) patients and body of incus was destroyed in 12 (11.8%) patients. Stapes suprastructure was intact in 54 (52.9%) patients and eroded in 48 (47.1%) patients (Table 2).

Malleus	Intact 69	67.6%
	Handle of malleus erosion 21	20.6%
	Complete erosion of malleus 12	11.8%
	102	100
Incus	Intact 6	5.9%
	Erosion of lenticular process 3	2.9%
	Erosion of long process 81	79.4%
	Erosion of body 12	11.8%
	102	100
Stapes	Suprastructure intact 54	52.9%
	Suprastructure eroded 48	47.1%
	102	100

Table 2. Details of Ossicular Chain Erosion

Ossicular Erosion according to Austin’s Classification

According to Austin’s classification M+S+ was seen in 33 (32.4%) patients, M+S- was seen in 30 (29.4%) patients, M-S+ situation was seen in 15 (14.7%) patients, M-S- was seen in 18 (17.6%) patients and intact ossicular chain in 6 (5.9%) patients.

Correlation of Type of Ossicular Defect with PTA and Mean ABG

In present study, in M+S+ situation the PTA was 46.98 dB and the mean ABG was 33.60 dB. In the M+S- situation the PTA was 41.80 dB and the mean ABG was 31.12 dB. The M-S+ situation revealed a PTA of 43.24 dB and a mean ABG of 32.94

dB, whereas in the M-S- situation the PTA was 55.83 dB and mean ABG was 39.68 dB.

Ossicular Erosion	PTA	Mean ABG
M+S+	46.98 +/- 13.87 dB	33.60 +/- 12.67
M+S-	41.80 +/- 8.88 dB	31.12 +/- 7.38
M-S+	43.24 +/- 9.72 dB	32.94 +/- 7.12
M-S-	55.83 +/- 7.35	39.68 +/- 4.89
P value	< 0.001	< 0.001

Table 3. Correlation of Type of Ossicular Chain Defects with PTA and Mean ABG

Correlation of Cholesteatoma Location with PTA and Mean ABG

In our study, the most common location of cholesteatoma in majority of patients was epitympanum- 48 patients with a PTA average of 43.81 dB and mean ABG of 32.46 dB. The PTA and mean ABG in patients with cholesteatoma involving the epitympanum, facial recess and sinus tympani was 53.30 dB and 36.60 dB respectively. The mean PTA of patients with cholesteatoma in various sites was 45.80 dB with a mean ABG of 33.39 dB.

DISCUSSION

Squamous epithelial type of CSOM causes significant morbidity to the patient and poses a therapeutic challenge to the otolaryngologist in terms of eradication of disease and restoring function. Ossicular damage is a common pathology associated with chronic suppuration of the middle ear. Although, ossicular chain erosion is seen in both types of CSOM, the propensity is much greater in case of squamous epithelial type due to the presence of cholesteatoma and granulations.

In the present study, the ossicular chain of 102 patients with CSOM squamous epithelial type was assessed intraoperatively. Male-to-female ratio was 1.6: 1, which correlated with literature. Majority of patients belonged to age group of 21 - 30 years, which is supported by the WHO report.¹ Majority of the patients had conductive hearing loss and incidence similar to that of De Azevedo.⁸ The hearing loss observed in our study was 45.80 dB (mean PTA) and mean ABG of 33.39 dB, which is similar to Martins⁹ study, which reported PTA of 41.3 dB in 158 cholesteatoma patients.

Malleus is a resilient ossicle. In our study, malleus was intact in 67.6% and eroded in 32.4% patients. The most common part to be eroded was handle of malleus- 20.6%. Sade et al also found malleus necrosis in 26% cases, which correlates with our study. Incus is the most common ossicle to be eroded. In our study, incus was intact in 5.9% and eroded in 94.1%. The most common part to be necrosed was the long process of incus 79.4%. Sade and Fuchs¹⁰ reported an incidence of incudal necrosis of 82.4% and Varshney¹¹ observed incudal necrosis in 85% of patients. A slightly higher incidence of incus erosion in our study can be attributed to the late presentation of patients and high frequency of bacterial infections. Stapes was intact in 52.9% and eroded in 47.1%, an observation which is similar to that of Sade and Varshney. Ossicular defects in our study revealed Type A to be the commonest 32.4%, which is similar to Kartush’s study.¹²

CONCLUSION

Squamous epithelial type of CSOM causes significant morbidity to the patient and poses a therapeutic challenge to the otolaryngologist in terms of eradication of disease and restoring function. Ossicular damage is a common pathology associated with chronic suppuration of the middle ear. Although, ossicular chain erosion is seen in both types of CSOM, the propensity is much greater in case of squamous epithelial type due to the presence of cholesteatoma and granulations.

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To conclude, our study demonstrates that ossicular erosion due to cholesteatoma correlates linearly with hearing loss and hence with pure tone audiometry. Hence, PTA plays an important pre-operative role in predicting ossicular chain discontinuity which would allow the surgeon to plan for ossiculoplasty. The patient can also be counselled regarding the hearing gain after surgery.

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