Original Research Article

Pattern of hearing loss in tubotympanic type of chronic suppurative otitis media

Vinay V. Rao*, Shilpa M. J., Mahesh Bhat

Department of ENT, Father Muller Medical College, Mangalore, Karnataka, India

Received: 05 June 2018
Revised: 02 August 2018
Accepted: 03 August 2018

*Correspondence:
Dr. Vinay V. Rao,
E-mail: drvinayvrao@gmail.com

ABSTRACT

Background: The aim of the study was to assess the degree of hearing loss with the pattern of tympanic membrane perforation in tubotympanic type of chronic suppurative otitis media (CSOM TTD).

Methods: This is a descriptive study conducted at Father Muller Medical College, Department of Otorhinolaryngology from Oct 2016 till Feb 2017. 110 cases aged between 20-50 years with CSOM TTD were included in the study. Detailed clinical examination and history was carried out followed by hearing evaluation by pure tone audiometry. All the data collected was statistically analyzed.

Results: 110 patients with 137 perforated tympanic membrane, aged between 20 to 50 years, were included in the study. Large central perforation involving all the four quadrants was the most common otologic findings. Significant correlation observed between size of perforation and degree of hearing loss (p value- 0.018) and no significant relation is observed between site of perforation and degree of hearing loss (p=0.107).

Conclusions: The larger the perforation, the greater the decibel loss in sound perception. The location of perforation does not have significant effect on magnitude of hearing loss.

Keywords: Otitis media, Hearing loss

INTRODUCTION

Chronic suppurative otitis media (CSOM) is quite a common otological condition and a preventable cause of hearing loss in developing countries. It is defined as “a persistent disease of insidious onset, often capable of causing severe destruction of middle ear structures with irreversible sequel, which is clinically manifested with deafness and discharge for more than three months”. CSOM is divided into two types (a) tubotympanic disease (TTD)– mucosal type (b) atticoantral disease (AAD)– squamosal type.

CSOM can lead to conductive hearing loss of up to 60 dB, which constitutes a serious handicap and the baseline investigation to assess the hearing in outpatient basis is Pure Tone Audiometry (PTA) which gives qualitative and quantitative analysis of hearing loss.

This study is an attempt to correlate the amount of conductive hearing loss with duration of disease and pattern of tympanic membrane perforation in CSOM – TTD.

The study was done with the aim to study the correlation of conductive hearing loss with the pattern of the tympanic membrane perforation and duration of the
disease in tubotympanic type of chronic suppurative otitis media.

**METHODS**

A prospective descriptive study was performed in the department of Otolaryngology-Head & Neck Surgery, Father Muller Medical College and Hospital Mangalore, from October 2016 to February 2017. A formal clearance from the ethics committee of the institute was taken before commencement of the study. 110 Patients suffering from CSOM TTD who were being operated were included in the study.

**Inclusion criteria for study group**

Inclusion criteria were patients with CSOM TTD; age group between 20 to 50 years; patients undergoing surgery for CSOM – TTD with intraoperative finding of intact and mobile ossicles; patients willing to participate in the study.

**Exclusion criteria for study group**

Exclusion criteria were patients with CSOM with atticoantral disease; the patients who have been operated in the same ear; patients with tympanic membrane perforation due to other causes such as trauma, tuberculosis etc; patients with complications of CSOM.

Detailed history was taken (special emphasis on onset and duration) and ENT examination done under microscope after suction clearance of debris and ear discharge if needed. These patients underwent hearing assessment by PTA and amount conductive hearing loss (AB gap) recorded.

For the purpose of the study, tympanic membrane perforation were grouped into anterior, posterior and central. Size of the tympanic membrane perforation is classified as small (perforation involving 25% of surface area), medium (perforation involving 25-50% surface area), large (perforation involving >50% surface area) and sub-total (only rim of tympanic membrane present). PTA was performed with or without masking. The pure tone audiometer used in our institute is a diagnostic audiometer – ORBITER 922 – Version 2. AB gap was calculated by taking difference between air conduction threshold and bone conduction threshold at 250Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz frequency. Average AB gap was correlated with duration of the disease, pattern of tympanic membrane perforation and hearing loss in frequencies with maximal AB gap. All the data was statistically analyzed by ANOVA F test at 95% confidence interval.

**RESULTS**

A total of 137 patients were included, age ranged between 20 to 50 years were studied. There were 87 females and 50 males. In terms of laterality, right sided perforation was seen in 62 and left sided in 75 patients respectively out of these bilateral membrane perforation was seen in 27 patients. There were 57, 35 and 45 patients in the age group of 21-30, 30-40 and 40-50 years respectively (Table 1).

| Age (years) | Frequency | Percentage (%) |
|-------------|-----------|----------------|
| 21-30       | 57        | 41.6           |
| 31-40       | 35        | 25.5           |
| 41-50       | 45        | 32.8           |
| Total       | 137       | 100.0          |

Patients were divided according to duration of ear discharge into <5 years, 5-10 years, >10 years and were correlated with the mean AB gap. No statistical significances seen between duration of disease and conductive hearing loss with p-value of 0.679 and 0.162 for left and right ears respectively (Table 2).

**Table 1: Age distribution.**

| Side  | N  | Mean  | Std. deviation | ANOVA F         | P value |
|-------|----|-------|----------------|-----------------|---------|
|       |    | <5 yrs | 28.2083 | 8.7650 | 23.8496 | 32.5671 | 0.389 | 0.679 NS |
|       |    | 5-10 yrs | 27.7292 | 9.5051 | 21.6899 | 33.7684 | 0.679 | 0.679 NS |
|       |    | >10 yrs | 26.5444 | 7.6667 | 24.8120 | 28.2769 | 0.162 | 0.162 NS |
| Left  |    | Total  | 27.1333 | 7.1694 | 25.4838 | 28.7829 |        |         |
|       |    | <5 yrs | 23.6023 | 9.3902 | 19.4389 | 27.7657 |        |         |
|       |    | 5-10 yrs | 27.1667 | 5.9891 | 20.2518 | 34.0815 |        |         |
|       |    | >10 yrs | 28.4924 | 4.1818 | 25.1529 | 31.8319 |        |         |
| Right |    | Total  | 26.5984 | 9.3319 | 24.2084 | 28.9884 |        |         |

N- Total number of patients, Mean- Average air-bone gap.
Table 3: Site of tympanic membrane perforation and its relation with degree of hearing loss.

| Side | N  | Mean   | Std. deviation | 95% confidence interval for mean | Anno F | P value |
|------|----|--------|----------------|---------------------------------|--------|---------|
|      |    |        |                | Lower bound                     |        |         |
| Left |    |        |                | Upper bound                     |        |         |
|      |    |        |                |                                 |        |         |
|      |    |        |                |                                 | 2.336  | 0.107   |
|      |    |        |                |                                 |        | NS      |
| Left | Ant| 16     | 23.8250        | 7.0692                          | 18.7680| 28.8820 |
|      | Post| 19    | 25.1250        | 6.0222                          | 21.2987| 28.9513 |
|      | Central| 38  | 28.8468        | 7.7701                          | 25.9967| 31.6969 |
|      | Total| 75    | 27.0566        | 7.4788                          | 24.9952| 29.1180 |
| Right| Ant| 16    | 22.6750        | 5.5491                          | 18.7054| 26.6446 |
|      | Post| 9     | 20.4164        | 2.8868                          | 13.2456| 27.5878 |
|      | Central| 37  | 27.8710        | 9.9463                          | 24.2226| 31.5193 |
|      | Total| 62    | 26.1818        | 9.1153                          | 23.4105| 28.9531 |

Ant- Anterior, Post- Posterior, N- Number of patients, Mean- Mean air-bone gap.

Table 4: Size of tympanic membrane perforation and its relation with degree of hearing loss.

| Side | N  | Mean   | Std. deviation | 95% confidence interval for mean | Anno F | P value |
|------|----|--------|----------------|---------------------------------|--------|---------|
|      |    |        |                | Lower bound                     |        |         |
|      |    |        |                | Upper bound                     |        |         |
|      |    |        |                |                                 |        |         |
|      |    |        |                |                                 | 3.564  | 0.018   |
|      |    |        |                |                                 |        | SIG     |
| Left | SCP| 7     | 20.0000        | 4.8412                          | 15.5226| 24.4774 |
|      | MCP| 22    | 26.6310        | 6.5663                          | 23.6420| 29.6199 |
|      | LCP| 37    | 27.8784        | 7.4206                          | 25.4042| 30.3525 |
|      | STP| 9     | 31.0000        | 5.8840                          | 25.9889| 36.0111 |
|      | Total| 75  | 27.1062        | 7.2057                          | 25.4250| 28.7874 |
| Right| SCP| 8     | 25.9688        | 10.8829                         | 16.8705| 35.0670 |
|      | MCP| 11    | 25.0000        | 10.6556                         | 17.3774| 32.6226 |
|      | LCP| 32    | 26.6953        | 9.0756                          | 23.4232| 29.9674 |
|      | STP| 11    | 28.2273        | 8.7325                          | 22.3607| 34.0938 |
|      | Total| 62  | 26.5984        | 9.3319                          | 24.2084| 28.9884 |

SCP- Small central perforation, MCP- Medium central perforation, LCP- Large central perforation, STP- Subtotal perforation, N- Number of patients, Mean- Mean air-bone gap.

Table 5: Frequency of maximum hearing loss and its relation to degree of hearing loss.

| Side | N  | Mean   | Std. deviation | Mean  | Anno F | P value |
|------|----|--------|----------------|-------|--------|---------|
|      |    |        |                | Lower bound |        |         |
|      |    |        |                | Upper bound |        |         |
|      |    |        |                |               | 0.683  | 0.508   |
|      |    |        |                |               |        | NS      |
| Left | 500 Hz | 50 | 27.3063        | 6.6580 | 25.1769| 29.4356 |
|      | 1000 Hz | 28 | 27.6339        | 7.8544 | 24.5883| 30.6796 |
|      | 4000 Hz | 7  | 24.1429        | 7.5095 | 17.1977| 31.0880 |
|      | Total  | 75 | 27.1333        | 7.1694 | 25.4838| 28.7829 |
| Right| 500 Hz | 34 | 26.6985        | 8.2756 | 23.8111| 29.5860 |
|      | 1000 Hz | 23 | 27.9432        | 10.8310| 23.1410| 32.7453 |
|      | 4000 Hz | 5  | 20.0000        | 7.8063 | 10.3073| 29.6927 |
|      | Total  | 62 | 26.5984        | 9.3319 | 24.2084| 28.9884 |

N- Number of patients, Mean- Mean Air-Bone gap, Frequency in hertz (Hz).

Site of the tympanic membrane perforation was correlated with the average AB gap, no statistical significance seen between site of the tympanic membrane perforation and the amount of conductive hearing loss with p-value of 0.107 and 0.154 for left and right ears respectively (Table 3).

Size of the tympanic membrane perforation was correlated with the average AB gap, statistical significant relation seen between size of the tympanic membrane perforation and the amount of conductive hearing loss with p-value of 0.18 and 0.886 for left and right ears respectively (Table 4).
The frequency with maximum air-bone gap was calculated, mean value derived and correlated with amount of hearing, statistically we found no significant relationship between representative frequency with maximum air-bone gap and the amount of hearing loss with p=0.508 and 0.231 for left and right ears respectively (Table 5).

**DISCUSSION**

The importance of an intact tympanic membrane and its role in amplification of sound cannot be overemphasized as various studies done across the globe have established it. Various studies have also tried to further characterize and note various parameters of hearing affected and tried to draw a correlation across these variables to give a better insight. There is still scope for further study to understand this correlation between characteristics of tympanic membrane perforation and its effect on hearing.

Certain studies have pointed out the site of perforation and its effect on hearing.\textsuperscript{3,5,7} The common pathophysiology implicated being the loss of round window shielding effect as seen in posterior quadrant perforation hence posterior perforation were found to have greater hearing loss although being smaller in size.\textsuperscript{5} However, we found that site of perforation has no bearing on amount of hearing loss. The probable cause for it is the loss of acoustic coupling caused by tympanic membrane perforation and the loss of major transformer mechanism in the middle ear irrespective of the position of the tympanic membrane perforation. The contradicting results in our study compared to other studies might be because the ossicular integrity was not confirmed in them, where the intact ossicular lever has an additive effect on sound transmission in normal ear.\textsuperscript{4,9} We included only those patients who underwent surgery for the same hence we can substantiate our results better.

Mahajan et al and few others correlated the size of tympanic membrane perforation and the amount of hearing loss, and they observed that the larger the size of perforation greater the hearing loss caused.\textsuperscript{1,5,5,7} We found similar results with greater AB gap seen in larger perforation supporting the loss of transformer action as the area ratio (the ratio of the tympanic membrane area to the stapes foot plate area) is directly affected. The sound pressure applied at the stapes footplate drastically reduces as affective surface area of the tympanic membrane participating in sound transmission is much less.

Majority of the studies indicate that the maximum hearing loss is seen more in lower frequencies and longer the duration of disease greater was the hearing loss which was unlikely in our study, where we found that the conductive hearing loss in tympanic membrane perforation is not frequency dependent and the duration of disease does not have statistically significant relation with the amount of hearing loss.\textsuperscript{1,3,5,10-12} The external auditory canal and the middle ear aids in sound conduction which is best represented at a resonating frequency of 3000 Hz, hence any pathology would best be seen at that frequency but it certainly does not change with the pattern of perforation as pointed out in earlier studies.\textsuperscript{3,5} We’ve deliberately left 3000 Hz out and seen any other frequency association. These results probably might be because the pattern of vibration becomes more complicated with tympanic membrane perforation wherein phase difference is lost and all the components vibrate asynchronously with different intensity leading to greater hearing loss.

Greater hearing loss was observed with longer duration of disease in other studies which have not specified if it’s sensorineural or conductive which could be the probable cause for such conclusion moreover in presence of a chronic perforation and frequent ear discharge there could be passage of toxin through the round window membrane causing sensory deafness.\textsuperscript{10,12} Since we’ve considered only AB gap and not individual thresholds hence we’re certain that only membrane perforation with an intact ossicular chain affect the conductive hearing loss and not the duration of the disease.

**CONCLUSION**

From this study it can be concluded that size of the tympanic membrane perforation affects the degree of hearing loss. Site of the tympanic membrane perforation and duration of the disease does not affect the hearing loss. Conductive hearing loss caused by tympanic membrane perforation is not frequency dependant. The limitation of this study was small number of cases and short study period. Though small but this study will help in better patient counseling and predict better surgical outcome.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rao VV, Shilpa MJ, Bhat M. Pattern of hearing loss in tubotympanic type of chronic suppurative otitis media. Int J Otorhinolaryngol Head Neck Surg 2018;4:1267-71.