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

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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.[1] Its prevalence ranges from 4% to 33.3% in developing countries.[2] 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".[3] 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.[4]

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 depending on relation to the imaginary vertical line passing along the handle of malleus and a second imaginary line bisecting the first at the level of umbo. Accordingly the perforations were classified as 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 theses 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).

Table 1: Age distribution.

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 significanceseen 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 2: Duration of ear discharge and its relation with degree of hearing loss.

Side		N	Mean	Std. deviation	95% confidence interval for mean		Annova F	P value
					Lower bound	Upper bound		
Left	<5 yrs	17	28.2083	8.7650	23.8496	32.5671	0.389	0.679 NS
	5-10 yrs	13	27.7292	9.5051	21.6899	33.7684		
	>10 yrs	45	26.5444	5.7666	24.8120	28.2769		
	Total	75	27.1333	7.1694	25.4838	28.7829		
Right	<5 yrs	22	23.6023	9.3902	19.4389	27.7657	1.878	0.162 NS
	5-10 yrs	7	27.1667	6.5891	20.2518	34.0815		
	>10 yrs	33	28.4924	9.4181	25.1529	31.8319		
	Total	62	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		Annova F	P value
					Lower bound	Upper bound		
Left	Ant	16	23.8250	7.0692	18.7680	28.8820	2.336	0.107 NS
	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	1.956	0.154 NS
	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		Annova F	P value
					Lower bound	Upper bound		
Left	SCP	7	20.0000	4.8412	15.5226	24.4774	3.564	0.018 SIG
	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	0.214	0.886 NS
	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		Annova F	P value
					Lower bound	Upper bound		
Left	500 Hz	50	27.3063	6.6580	25.1769	29.4356	0.683	0.508 NS
	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	1.505	0.231 NS
	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.[5-7] The common patho-physiology 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.[8] 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.[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.[1,5,3] 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.[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.[1,3,5] 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.[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.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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