Original Article

Assessment of Hearing Loss in Tympanic Membrane Perforation at Tertiary Care Hospitals

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ABSTRACT

OBJECTIVE: To evaluate and analyze the degree of deafness in tympanic membrane perforation based on size, site and duration of perforation.

METHODS: 90 patients of both sex were selected randomly for this study with age 20 years and above randomly. Size of tympanic membrane perforation was evaluated under operating microscope. Patients were divided into three groups according to size; group I (small), Group II (medium), Group III (large). Hearing loss was measured in each case with pure tone audiometry.

RESULTS: Deafness increased as the perforation size increased [I vs. II (t - 3.23,p <0.01), II vs. III (t - 7.19, p < 0.001), I vs. III (t - 10.88, p < 0.001)]. The degree of deafness was more in posterior quadrant perforation than anterior quadrant perforation but difference was not significant statistically (t - 1.25, p (0.05). The degree of deafness was more in malleolar perforation (t - 4.64, p < 0.01). Deafness increased as the duration of disease increased [A vs. B (t - 3.01, p < 0.03), A vs. C (t - 6.49, p < 0.001), B vs. C.

KEYWORDS: Perforation, Deafness (Hearing loss), Tympanic membrane.

INTRODUCTION

Tympanic membrane separates middle ear from the external ear, measuring 9-10 mm vertically and 8-9 mm horizontally. It transmits sound in middle ear[1]. Apart from conduction of sound waves across the middle ear, the tympanic membrane, also sub-serves a protective function to the middle ear cleft and round window niche. Intact tympanic membrane protects the middle ear cleft from infections and shields the round window from direct sound waves which is referred to as 'round window baffle [2]. Tympanic membrane perforation usually results from trauma and middle ear infections. Tympanic membrane perforation causes conductive deafness. A perforation on the tympanic membrane reduces the surface area of the membrane available for sound pressure transmission and allows sound to pass directly into the middle ear. As a result, the pressure gradient between the 'inner' and 'outer' surfaces of the membrane virtually becomes insignificant. The effectiveness with which the tympanic membrane transmits motion to the ossicular chain is thus impaired along with the level of hearing. It has been established that the larger the perforation on the tympanic membrane, the greater the decibel loss in sound perception. A total absence of the tympanic membrane would lead to a loss in the transformer action of the middle ear [3]. Deafness is a common health problem with physical and psychosocial issues; therefore tympanic membrane perforation should be treated as early as possible because tympanic membrane perfo -ration leads to serious changes in the tympanic cavity, thus increasing the degree of deafness [4]. The purpose of this study is to investigate the relationship between the Size and site of perforation on TM and the magnitude of hearing deficit in our patients. The incidence of otitis media and tympanic membrane perforation is high in our region; so we have undertaken this study.

MATERIALS AND METSHODS

Study design: Descriptive observational study
Sample size: This study was conducted on 90 patients
Study setting: Departments of ENT, Liaquat University of Medical and Health Sciences Jamshoro & Civil Hospital Karachi.
Study duration: 2004 to 2010 of either sex and of age 15 years and above
Inclusion Criteria: patients presenting with dry perforations of tympanic membrane with no history of active middle ear disease, unilateral or bilateral, were selected randomly.
Exclusion criteria: patients with co-morbidities like diabetes, hypertension or any other chronic diseases were excluded.
Data collection procedure: A thorough history was taken in each case, followed by detailed examination and investigations. Then, the evaluation of hearing loss was done in each case of dry tympanic membrane perforation with no history of active middle ear disease

at the time of presentation, depending on the size, site and duration of perforation.

Depending upon the area, perforations patients were divided into 3 groups:

Group I = Small perforation

Group II = Medium sized perforation

Group III = Large perforation.

The location of each perforation was determined anterior or posterior.

Perforations and divided into malleolar or non-malleolar depending upon whether the malleus was involved or not.

Depending upon the duration of disease, perforations were divided into 3 groups:

Group A = <1 year

Group B = 1–6 years

Group C = >6 years

Routine Investigations Blood CP and X-ray were performed. The type, degree and frequency of hearing loss was determined by Tuning fork test and Pure tone audiometry. The association of degree of hearing loss was matched with the characteristics of perforation and result obtained was evaluated.

Data Analysis tool: SPSS 17 was used for data analysis.

RESULTS

The study comprised of 90 patients. Graph I shows the gender distribution i.e. male patients were 50 and females were 40. Out of 90 cases, 35 patients right side ear was involved, 45 were with left side ear involved and 20 patients had both in side ear involved Graph II. Twenty five (27.7%) patients having disease duration <1 year and cause was trauma while 35 (38.8%) patients had disease duration 1–6 years, and 50 (55.5%) patients having disease >6 years.

According to the size of tympanic membrane perforation, most of the patients were in group I i.e. 50(55.5%) followed by 40(44.4%) in group II and 20 (22.2%) in group III. Table I.

Based on the site of perforation, they were divided into anterior, posterior and involving multiple quadrants. 50 (55.5%) ears had perforation in the anterior quadrant which were further subdivided into superior and inferior, thus they were classified as AS 3 (6%), AI 15 (30%).

40(44.4%) had perforation in the posterior quad-rant which were further subdivided into PI 9 (22.5%), PS 4 (10%).

20 (22.2%) had perforation involving the multiple quadrant. In this group those per-forations had been taken which had either involved both the anterior and posterior quadrants together like AI and PI 1 (1%) or had involved more than 2 quadrants like PI and AI and AS 2 (10%) and involving all the 4 quadrants i.e. AS, AI, PS, PI 4 (20%) ears.

In the present study, 11 (10%) cases involved malleus and 99 (90%) cases malleus was not involved. Handle of malleus was involved in disease having long duration.

Rinne's test was negative in all patients (100%) cases. Weber's test was lateralised to +diseased ear in 99 (90%) cases while, 11 (10%) cases had undefined Weber's; because of patient having almost equal hearing loss on both sides.

X-ray mastoids of 90 patients revealed sclerosis in 68% patients and cellular mastoid in 32% patients.

In our results hearing loss increased with size of perforation at each frequency. In group I (small) the mean hearing loss at 250 Hz was 19 and at 4000 Hz was 8. In group II (medium), the mean hearing loss at 250 Hz was 29 and as the frequency increased hearing loss declined. In group III (large), the mean hearing loss at 250 Hz was 39 and 20 at 4000 Hz.

In this series of patietns, perforations were divided into three groups anterior (AI, AS,), posterior (PI, PS,), Multiple (AI PI, PI AS AI, all 4). Hearing loss was calculated at each frequency. Hearing loss for anterior perforation at 250 Hz was 29.46, for posterior perforation 35.18 and for the perforation with multiple quadrant involvement was 47.28 As the frequency increased hearing loss showed a decline trend.

Comparison revealed that posterior perforation caused more hearing loss than anterior perforation at all the fre-quencies. But the difference was not significant statistically as shown in Graph III. Site of perforation causes insignificant loss on hearing.

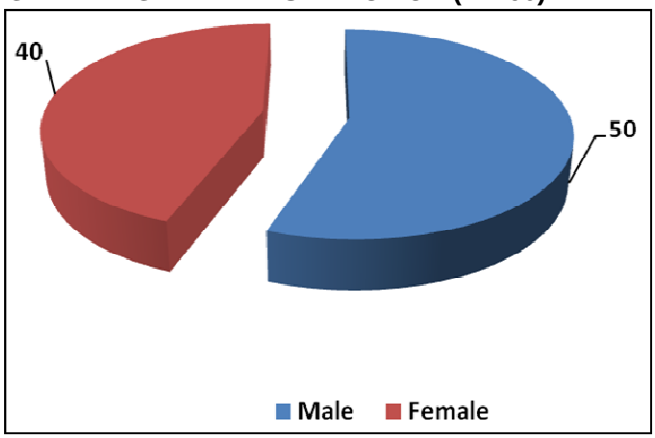
Average hearing loss in malleolar perforation was 42.02± 4.70. Average hearing loss in non-malleolar per-foration was 26.25 ± 10.90. Hearing loss in malleolar perforation was more than non-malleolar perforation. Dif-ference was significant statistically ('p' value < 0.001) as shown in Graph IV.

In this study, hearing loss was increased with the duration of disease as shown in Graph V.

All the perforations were divided into three groups according to duration of disease and hearing loss at each frequency was noted in all the groups. Hearing loss at 250 Hz in group A (<1 year) was 22.78± 10.21and in group B (1–5 years), it was 27.43± 8.53and in group C (C5 years) 35.83 ± 10.10.

We found that hearing loss was higher in group C where as it was lower in group B and group A respectively.

GRAPH I: GENDER DISTRIBUTION (n = 90)



GRAPH II: EAR INVOLVED (n = 90)

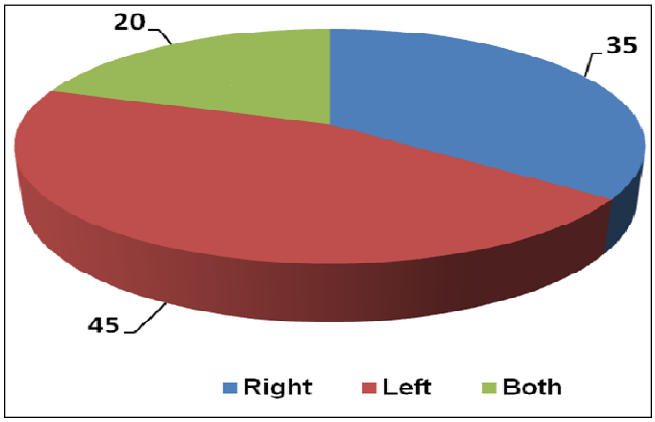
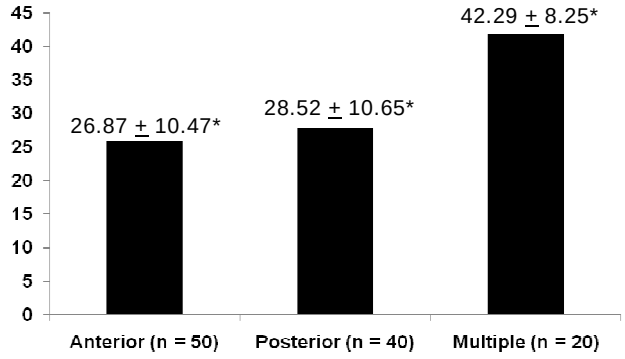


TABLE I: COMPARISON OF AVERAGE HEARING LOSS OF ALL THE GROUPS (ACCORDING TO SIZE OF PERFORATION)

Groups		Average hearing loss (range in db)	Mean ±SD (in db)
Group I (small) (n=50)		10.7–61.67	22.90 ± 10.05
Group II (medium) (n=40)		14.0–48.33	30.07 ± 8.44
Group III (large) (n=20)		30.7–56.67	44.51 ± 7.32
Groups	**'t' value**	**'p' value**	**Significance**
I vs. II	3.23	< 0.001	Highly significant
Ivs.III	10.88	< 0.001	Highly significant
II vs.III	7.19	< 0.001	Highly significant

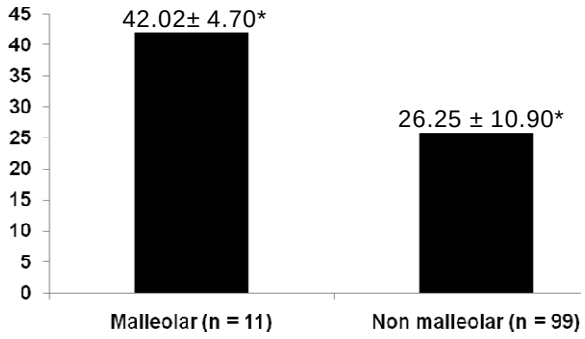
GRAPH III: COMPARISON OF AVERAGE HEARING LOSS OF ALL THE GROUPS (ACCORDING TO SITE OF PERFORATION)



Groups	't' value	'p' value	Significance
Anterior vs. posterior	1.13	0.05	Not significant
Anterior vs. multiple	5.27	<0.001	Highly significant
Posterior vs. multiple	6.65	<0.001	Highly significant

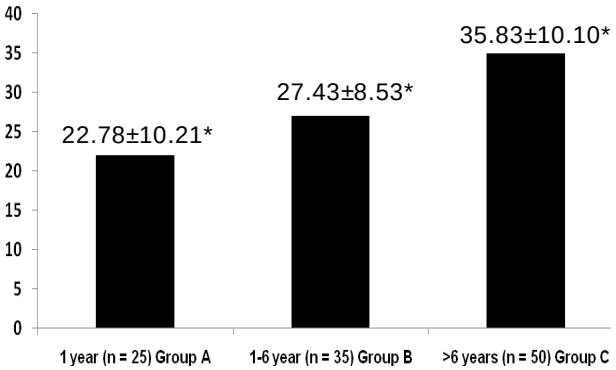
*Results are presented as Mean ± Standard Deviation

GRAPH IV: (TABLE IV) COMPARISON OF AVERAGE HEARING LOSS IN MALLEOLAR AND NON MALLEOLAR PERFORATION



* Results are presented as Mean±Standard Deviation
't' value=4.74, p value=<0.00001(highly significant)

GRAPH V: (TABLE V) COMPARISON OF AVERAGE HEARING LOSS OF ALL THE GROUPS (ACCORDING TO DURATION OF DISEASE)



Groups	't' value	'p' value	Significance
A vs. B	3.01	0.05	Significant
A vs. C	6.49	<0.001	Highly significant
B vs. C	5.13	<0.001	Highly significant

DISCUSSION

The tympanic membrane (TM) serves as a key component of the tympano-ossicular system for sound transmission. Perforation of the TM is common in an otologic practice and can result from various causes such as trauma and chronic otitis media. Perforations of the TM can result in a hearing loss (HL) that ranges from negligible to 50 dB [5].

This study includes 90 patients. 20 cases had involvement of both ears, so total number of ear involved in this study was 110.

This study presents a mean age was 30.27 with std. deviation ± 10.49, ranging from 20 – 60 years whereas the western literature shows lower mean age, Caye Thomasen et al. reported13.3 years as a mean age [6].

In our observation, 55.5% patients were males and 44.5% were females. Male to female ratio was 1.25:1. A western study reported 59.5% male and 40.5 % female patients. Kurian also reported closer findings with 55% of his patients as male [7].

Mojority of the patients in our study were belonging to rural areas. Bansal et al [8] also reported that majority of the patients having chronic suppurative otitis media were from rural areas.

In this study, 80 (80%) patients had unilateral disease with 30 (30%) in right ear and 50 (50%) left ear, 20 (20%) patients were having bilateral disease. Otitis media was seen the most common (84%) reason identified in this study while trauma was the next leading cause of tympanic membrane perforation. In an international study reported the etiology of perforation was infection and auditory tube malfunction in 62% cases, trauma in 28% and cholesteatoma in 10% cases respectively [9]. While in an another international study showed that the trauma was most common reason for the perforation of tympanic membrane followed by the chronic suppurative otitis media [10].

The presenting symptom in this study was hearing impairment in 91%, while the aural heaviness in 84% of cases respectively. Baumann et al. [11] in their study mentioned that main symptoms were discharge, deafness and tinnitus.

This study showed that the severity of hearing impairment increased with increase in size of perforation at each frequency. In the study of Mehta et al [12] reported that deafness is greater in the lower frequencies in small perforation while increasing in the size of the perforation the hearing impairment was also increased and affecting the high frequencies as well. They also mention that the hydraulic action developing from the difference in area of TM and of the stapedial footplate is the major factor in impedance matching. When the surface area is decreased, there will be decrease in amplification and deafness will be equal to size of perforation. In the study of Voss et al. [13], he also observed that hearing loss increased as the perforation size increases. Baumann et al, reported a linear relation between size of perforation and amount of hearing loss.[11]

In this study the site of the perforation didn't depend upon the degree of hearing impairment. Our finding was similar as in the international literature [14]. Shambaugh et al [15] in their study of 42 patients with tympanic membrane perforation into anterior and posterior groups and they observed that there was no statistically significant difference in both groups. In another study conducted by Mehta et al.[12] they stated that deafness does not vary substantially with area of the perforation. Impact of area, if any, are negligible. In the study of Saha et al. [16] reported that central large perforations had high degree of deafness than peripheral perforations.

This study represent that the hearing deficit is major health problem in our population and the etiology of this was the tympanic membrane perforation either by the diseased process or the trauma which is most common in the teachers and younger's but somewhat is also common in the rural areas female where husband beat their wife. This is the time to educate the people for severe consequences.

CONCLUSION

In our study we have found that the degree of deafness increased statistically as the perforation size increased. Effect of area, if any, on the hearing loss was small. The mean degree of deafness increased as the time of disease increased and the difference was statistically significant.

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