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ORIGINAL ARTICLE

To study correlation between size and site of tympanic membrane perforation and degree of hearing loss in patients with chronic otitis media

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ABSTRACT

OBJECTIVE: To find the correlation between size and site of tympanic membrane perforation and degree of hearing loss in patients with chronic otitis media**.**

METHODS: This is a prospective observational study conducted in Otorhinolaryngology department at Jinnah Postgraduate Medical centre hospital, from February 2020 till February 2021.

METHODOLOGY: Sample size 103 patients with age of 10 to 65 years diagnosed clinically having chronic otitis media of inactive mucosal type were included. The condition of tympanic membrane and the site and size of its perforation were observed and the middle ear's mucosa & ossicles were examined. Data was entered and analyzed in SPSS.

RESULTS: A total of 206 ears of 103 patients were included in the study. Condition of the tympanic membrane and site and size of tympanic membrane perforation were observed and they were correlated with audiometric assessment. There were 60 (58.25 %) males and 43 (41.75 %) females with age ranged from 10 – 65 years. Perforations involving the posterior half of the tympani membrane showed greater hearing loss as compared to those perforations involving the anterior half of the tympanic membrane. With regard to the size of the tympanic membrane perforation we observed that more the size of the perforation, greater was the hearing loss.

CONCLUSION: The conclusion of the study that maximum hearing loss is seen in perforations involving postero-superior quadrants of tympanic membrane The greatest level of hearing loss was observed when perforation occurred in all four quadrants.

Keywords: Otitis media, perforation, tympanic membrane, hearing loss

INTRODUCTION:

Chronic otitis media is an inflammatory condition of middle ear mucosa and has been known in human skeleton from prehistoric times. It is the commonest disease in otorhinolaryngological practice that needs medical attention, especially in children from low socioeconomic backgrounds who have not received proper treatment with poor compliance to therapy. Otorrhea for duration of at least 6 weeks, presenting with a perforation of the tympanic membrane (TM) constitutes chronic otitis media. According to several studies, frequency range from 3 to 17.74 percent in India and Pakistan, It varies in urban and rural populations. The eastern Mediterranean region estimate was based on the Saudi Arabian frequency rate comprising 1.5%. Children in a Brazil had a frequency comprising 1.5%, which was thought to be representative of South America, and a frequency of 0.4%, which was thought to be indicative of Europe.(4)

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Studies have shown that hearing loss in chronic otitis mediais directly proportional to the size and site of the tympanic membrane perforation and it seen that posteriorly based perforations have worse audiometric thresholds at lower frequencies (500 Hz). It is seen that hearing loss increases with increasing size of the TM perforation ($r = 0.435$, $p < 0.0001$). Posteriorly based perforations had a 12% greater hearing loss as compare to anterior based perforations but this was significant only at the frequency of 500 Hz ($p = 0.02$). There was a direct and pragmatic correlation between the otoscopic extimation to estimate the of the size of the perforation with the endoscopically obtained images for same purpose.

In more than 50% of patients, chronic otitis media results in mild to moderate hearing loss. Usually, there is increase in normal air-bone conduction thresholds in patients with COM who have hearing loss. The size & location of the tympanic membrane defect, ossicular chain dysfunction, & middle ear condition that affects the sound conduction

mechanism are all factors that affect the kind & degree of deafness. While most of the researchers believe that site of perforation is related with degree of hearing loss, on the contrary there are several researchers who have also noted that there is no significant correlation.

If we observe the south-east Asian countries, prevalence rates in Thailand ranged from 0.9 to 4.7%, in India prevalence rate as observed by various researchers ranges from 3 to 7.74%. It is different in urban and rural populations. Prevalence of 1.5% amongst children in Brazil was considered representative of South and Central America and in Europe a prevalence of 0.4% was observed in studies.

In Thakur and Dawood et al., the size of the perforation has no bearing on the degree of hearing loss, which increases. Dudda et al. found that the site of the perforation rather than its size determined the degree of hearing loss in their study. Additionally, there was poor correlation between frequency dependence of hearing loss and the size and severity of the loss.

While the limited number of studies in this area there are not enough experimental and clinical research due to complex structure of the tympanic membrane & the middle ear functions. The objective of the study is to determine the association of hearing with different types of tympanic membrane perforation in patients with inactive mucosal chronic otitits media.

STUDY METHODS: This prospective observational study was carried out in Otorhinolaryngology Department at Jinnah Postgraduate Medical Centre. This study was carried out from February 2020 to February 2021. Sample size 103 was calculated with 80% power of test and 5% level of significance by taking expected Otitis media percentage. Patients age with 10 to 70years diagnosed clinically having chronic otitis media of the inactive mucosal type, and healthy looking middle ear mucosa with normal eustachian tube function were included. Patients having causes of hearing loss other than COM, such as presbycusis, trauma and those on ototoxic drugs, were excluded.

Before filling the proforma Informed consent was taken. Detailed clinical history and demographic data were recorded. Welch Allyn's otoscope and microscope were used to do a full ear examination. The condition of tympanic membrane and the size and site of its perforation were observed, and the mucosa of middle ear & ossicles were carefully examined.

The hearing assessment was performed in patients using a clinical audiometer, according to ISO standard in sound treated room. The frequencies which were used for this study were 250-8000 Hz. Each time proper masking approach was used to calculate the air and bone conduction threshold. The mean air conduction threshold at 500,1000, 2000 & 4000 Hz were used to define hearing level and the average of these frequencies was used to assess the hearing level. According to the WHO grading system, hearing loss was found. Data was entered and analyzed in SPSS version 21. Age was presented as mean and SD. Duration of discharge from right and left ear, site and size of tympanic membrane perforation and type of deafness and degree of hearing loss were presented as frequency and percentage.

RESULTS: Total 103 patients fulfilling the inclusion criteria were include in study. A total number of 206 ears of 103 patients were examined and studied. Age ranged from 10 years to 65 years, with mean age 26.87 ± 13.28 years. Out of 103 patients included in study, 60 (58.25%) were males and 43 (41.75%) were females. There were 79 (76.7 %) patients in 10-30 years of age group, 10 (9.7 %) were from 31-50 years age group and 14 (13.6 %) were between 50-65 years age group.

In 206 tympanic membrane examined 125(60.67 %) tympanic membranes presented with perforation. In 206 ears examined where perforation was seen in 125 ears it was unilateral in 81(78.7 %) ears and it was bilateral in 22(21.3 %) ears. In unilateral cases right ear was involved in 33(40.7 %) and left ear was involved in 48(59.26 %). On detailed examination of the site and size of the tympanic membrane we observe that the perforation involving single quadrant of tympanic membrane were seen in 22(18.33 %) of ears, while 71(56.8 %) of perforations were involving 2 quadrants of the tympanic membrane and perforation involving 3 quadrants of tympanic membrane were seen in 13(10.04 %) of tympanic membrane. In 19(15.2 %) perforations all 4 quadrants of tympanic membrane were involved. On assessment of site and location of tympanic membrane perforation it was seen that 33(26.4 %) of tympanic membrane perforation were anterior to the handle of malleus, 43(34.40 %) perforation were posterior to the handle of malleus, in 49(39.2 %) perforations handle of malleus was involved.

In cases where perforation was present , there were 89 (71.2 %) cases of conductive hearing loss, 19 (15.2 %) cases were of sensorineural hearing loss and 11 (9 %) were mixed hearing loss, while 6(4.8 %) tympanic membrane showed normal hearing. On hearing assessment of tympanic membranes with perforation we observed that out of 125 tympanic membrane studied 47 (37.6 %) presented with mild hearing loss(25 to 40Db) , in 51 (40.80 %) tympanic membranes hearing loss was moderate(41 to 60 dB), in18 (14.40 %) tympanic membranes hearing loss was moderate to severe(61 to 75dB) and in 7 (5.6 %) hearing loss was severe(75 to 90dB) whereas in 2(1.6 %) tympanic membranes with perforation hearing loss was profound(>90dB). (Fig – 1)

In our study perforations were divided into anterior (AI, AS, AS + AI), posterior (PS, PI, PS + PI) and both types (AI + PI, AI + PI + PS). Perforation involving the posterior half of the tympanic membrane showed greater hearing loss than those involving the anterior or inferior half of membrane. Statistically maximum hearing loss was observed where perforation involved all 4 quadrants of tympanic membrane.

Mean hearing loss ranged from 20.00?±?4.0 to 42.5?±?5.2ÊdB in single quadrant perforations out of which maximum loss was seen in postero-superior perforations followed by perforations involving postero-inferior quadrant of tympanic membrane. Antero superior perforations showed the minimum hearing loss. This difference in mean hearing loss due to difference in place of perforation was found to be statistically significant (pÊvalue <?0.05). In perforations involving two quadrants of tympanic membrane hearing loss ranged from 28.32±2.1 to 32.3±6.5 dB and in these perforations maximum hearing loss seen in perforations involving the posterosuperior and postero inferior quadrant of tympanic membrane.

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Table: 1 Descriptive of Age and Gender

Table 1: Distribution of different pathologies

		Frequency (%)
Age	Mean ± SD	26.87+13.28
	10 - 30	79(76.7%)
	31 - 50	10(9.70%)
	51 - 65	14(13.6%)
Gender	Male	60(58.3%)
	Female	43(41.7%)

Table: 2 Hearing loss in tympanic membrane perforation

Type of hearing loss	No.	Percentages
Conductive Hearing Loss	89	(71.21 %)
Sensorineural Hearing Loss	19	(15.2 %)
Mixed Hearing Loss	11	(9 %)
Normal Hearing	6	(4.8 %)

Figure: 1 Degree of Hearing Loss

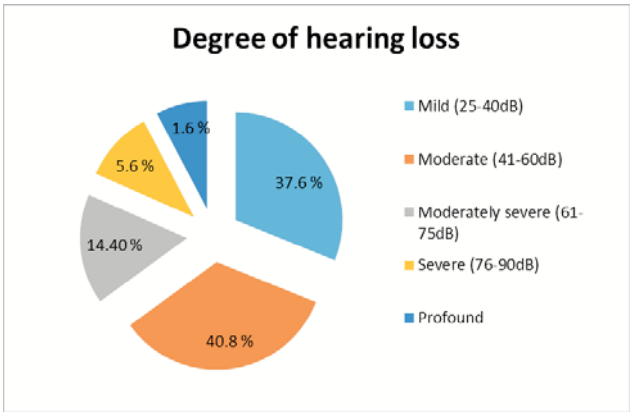

Table: 4 Distribution of hearing1loss in dB

	Hearing1loss in dB	P value
Single Quadrant		
AS	20 +4.0	
PI	30.2+ 5.1	< 0.05
AI	28.0 +8.2	
PS	42.5 +5.2	
Two Quadrant		
AI+AS	28.32+ 2.1	
PS+PI	45.3 +7.0	< 0.05
AI+PI	32.3 +6.5	
Three Quadrant		
AI+PI+PS	42.1 +6.0	

DISCUSSION:

Tympanic membrane perforation can occur following an acute or chronic infection of the middle ear or after a trauma. While the effects of perforation on the middle ear's sound conduction mechanism are complex and poorly defined, We know that isolated membrane perforations with intact ossicles may result in conductive hearing loss up to 50.0dB (12,13)

It is well recognized that hearing loss can occur in people who simply have a perforated tympanic membrane and healthy middle ear components, especially at low frequencies, & that as frequency rises, increase hearing threshold as well. Additionally, larger perforations usually result in more severe hearing loss (14,15), due to a reduction in the tympanic membrane's physiologically vibrating area and/or a decrease in the proportionate difference between the tympanic membrane as well as the base of the stapes (13).

For the transmission of sound from the outer ear to the inner ear, wherever it is converted into nerve impulses that result in hearing, the tympanic membrane (TM) & continuity of the ossicular chain are both required.

The most common finding in our study is conductive hearing loss. Edie et al. proposed that this is caused by a decrease in membrane surface area, which is amplifying sound waves (7). Studies by Ankle, N.R. et al. and Homans, NC et al. revealed a high frequency of conductive hearing loss (16,17). Mohammad et al., stated that conductive hearing loss affected 80.8 percent of cases, whereas mixed hearing loss affected 17.17% and 2.01% of the patients had sensorineural hearing loss (13). Aneesa et al. reported that mixed hearing loss made up 7.83% of cases, while conductive hearing loss made up 92.17%. No patient had sensorineural hearing loss (19).In a study of 80 patients, Kabdwal et al. found that 37.70% of patients had mild hearing loss & 11.47% had substantial hearing loss. In their study, Muftah et al. found that mild hearing loss affected 37.3% of patients while moderate loss (20). affected 25.4% of patients (21). Patients with severe hearing loss made up 3.9%. There were 67.5% of patients showed mild (7) conductive hearing loss, according to Ediale etal..According to Darad et al., 19% of patients had substantial hearing loss, whereas 79 percent of patients mild hearing loss (22). Mean hearing loss of 51.56 ± 5.1 dB was seen in perforations which were total/subtotal or present in all the four quadrants. Perforations present in postero-superior quadrant also resulted in high degree of hearing loss (48.60 ± 5.5 dB). Perforations present in inferior half of membranes resulted in 36.40 ± 6.8 dB of hearing loss. One study was conducted by Kumar are in agreement with our study (23). In 2018 study reported multi quadrant perforations presenting with 39.34 ± 9.47 dB hearing loss and those having postero-inferior perforations having 34.82 ± 10.79 dB hearing loss (24). In Anterior half perforations, average hearing loss was 33 dB. The difference was not statistically significant in their studies. One study found out perforations (25) of posterosuperior quadrant had largest air–bone–gap. Similarly Maharajan etal (26). and Nepal etal (27). showed statistically significant relationship between site of perforation and hearing loss. In 2009 study concluded that location of perforation is only significant in cases of chronic perforations whereas has no significance in acute cases (28). One research concluded that malleolar perforations had higher hearing loss (29). Another study observed that hearing loss for anterior perforation was 31.56 ± 13.77 dB whereas it was 36.29 ± 10.17 dB and 49.39 ± 10.26 dB for multiple quadrant perforations (6).

Patients who experienced symptoms for more than a years on average hearing loss of 52.17±4.2 dB, whereas those who had symptoms for less than a year on average loss of 36.46 8.2 dB.In their research, Amali etal (8). and Maharjan etal (24). found a significant correlation between the length of ear discharge & hearing loss.

CONCLUSION: The conclusion of the study that maximum hearing loss is seen in postero-superior quadrants & minimum in anterosuperior quadrants. The greatest level of hearing loss was observed when perforation occurred in all three quadrants. Even though conductive hearing loss was the common type,the existence of sensorineural and mixed hearing loss demonstrates that inner ear involvement cannot be ruled out in mucosal disease. If patients with chronic otitis media receive early diagnosis & treatment, high auditory loss may be avoided. Additionally, if perforations are found in location of tympanic membrane where there is a greater hearing loss, patients can be recommended to get early care.

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