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RELATIONSHIP OF THE SIZE AND LOCATION OF THE TYMPANIC MEMBRANE PERFORATION IN CHRONIC SUPPURATIVE OTITIS MEDIA WITH THE MAGNITUDE OF HEARING LOSS

Chronic suppurative otitis media is a severe health condition that affects people worldwide. Perforation in the tympanic membrane reduces the surface area of the membrane available for sound transmission. It's important to identify and treat tympanic membrane perforation as soon as possible, since untreated tympanic membrane perforation contributes to chronic disruptive changes in the middle ear, resulting in further hearing loss, which is a major physical and psychological issue that affects people's lives. The study has been conducted to compare the relationship between the location and size of perforation of the tympanic membrane in chronic suppurative otitis media with the magnitude of hearing loss. The cross-sectional prospective study was conducted among 67 patients who visited the Otorhinolaryngology department for myringoplasty. The study period was from January to April 2021, the age group of patients was between 8 and 43 years old. The number of female participants was 35 (52.2%) and males – 32(47.8%) respectively. Average age ±SD was 21.93±9.47 years. Fifty (74.6%) patients had right ear perforation and seventeen (25.4%) with left ear perforation/ It was not statistically significant ($\chi^2=22.891$; p-value=0.290). Most of the patients were with subtotal of (all quadrants) 30 (44.77%), 2-3 quadrants, and one quadrant perforation were 23 (34.32%) and 14 (20.89%) respectively. Most of the patients, i.e.37 (55.22%), had hearing loss between 26-40dB. There was a significant connection between the perforation size and degree of hearing, ($\chi^2=22.891$; p-value <0.0001). In one quadrant perforation, greatest hearing loss was on the post inferior quadrant 29.97±4.32 dB. For 2-3 quadrants perforation the hearing loss was greatest in postero-superior combined with postero-inferior perforation 37.42±9,59dB. The most significant hearing loss was in subtotal perforation mean ±SD was 42.13±7.07dB. Hearing loss increases in proportion to the extent of the perforation, post inferior quadrant alone and combined with the post-super were observed with the greatest hearing loss according to the findings of this study.

Key words: Chronic suppurative otitis media; Hearing loss degree; Perforation; Tympanic membrane.

Introduction

Chronic suppurative otitis media (CSOM) is a severe health condition that affects people all over the world [1]. Chronic suppurative otitis media is characterized by inflammation of a portion or the entire muco-periosteal layer of the middle ear. In spite of improved hygiene and treatment, it is still a major health concern in both developing and developed countries [2-3]. The tympanic membrane, which measures 9–10 mm vertically and 8–9 mm horizontally, separates the external ear from the tympanic cavity. It's an essential part of the sound transmission through the middle ear, and it takes part in impedance matching mechanism of the middle ear cleft [4].

The Perforation of the tympanic membrane (TM) refers to a partial or complete rupture of the eardrum. The tympanic membrane may be perforated as a result of trauma, middle-ear disease, or treatment of the middle-ear disease. Perforated tympanic membrane reduces the surface area of the membrane available for sound transmission, allowing sound to travel directly through the middle ear. As a result, the effectiveness with which the tympanic membrane transmits vibration to the ossicular chain is limited, along with the range of hearing [5-7].

A total absence of tympanic membrane will result in a loss in the transformer action of the middle ear [5]. Hearing loss is a major physical and psychological issue that affects people all over the world. As a result, it's important to identify and treat tympanic membrane perforation as soon as possible, since untreated perforated tympanic membrane contributes to chronic disruptive changes in the middle ear, resulting in further hearing loss [8].

Some tympanic membrane perforations were improperly handled by general practitioners and family doctors, resulting in a delay in visiting otolaryngologists. Chronic TM perforations may

grow as a result of late visits [9]. In chronic otitis media, which affects at least 0.5 percent of the population, perforation occurs as a consequence of the disease process. CSOM can cause conductive hearing loss(CHL) of up to 60 decibels, which is a significant handicap [6].

Aim of the study: To analyze the relationship between the location and size of perforation of the tympanic membrane in CSOM with the magnitude of hearing loss.

Materials and Methods

Study design

This cross-sectional prospective study was conducted in 67 patients who visited the Otorhinolaryngology department of the Aksy University Hospital, Almaty, for myringoplasty (type1 tympanoplasty). The study lasted from January till April 2021.

Study population

Sixty-four cases were done under general surgery and 3 cases – in local anesthesia. Patients with tubotympanic type of CSOM, age group of 8–43 years were candidates for myringoplasty included in this study. Patients under the age of 8 years, as well as those with co-morbid diseases like hypertension, diabetes mellitus, bleeding diathesis, mixed or sensory neural hearing loss (SNHL), CSOM attico-antral type, ossicular chain fixation or disruption are excluded.

According to the extent of perforation, patients were divided into three categories: one quadrant perforation, two or three quadrants perforation, and subtotal perforation (all quadrants or four perforations).

Audiogram and imaging

History was reviewed with full ear, nose, and throat clinical examination for each case. During surgery microscopic analysis confirmed the results from the pre-operative exam. Pure tone audiogram (PTA) was performed for all of them and the grading of hearing loss was scaled according to WHO classification [10]. "Hearing-level" was defined as the mean air conduction (AC) threshold at 500, 1000, 2000, and 4000 Hz, and the average (pure tone average or PTA) of these frequencies was calculated to measure the hearing level.

Audiogram was used to measure conductive hearing loss due to the tympanic membrane perforation. The audiogram close to the time of operation was selected. A pre-operative temporal bone CT scan was mandatory for all cases.

Statistical processing

All data were entered into an Excel sheet. Statistical package for social science 24 (SPSS) was used for data analyses. The chi-square test and t-test were used to analyze the variations in proportions, and for the difference between the mean value of all groups, one-way ANOVA was applied for interpretations, P-value of less than 0.05 was considered statistically significant.

Ethical consideration

All patients provided with their informed consent. None of the authors conducted any human experiments for this paper.

Result

A total of 67 cases (67ears) were studied with number of females being 35 (52.2%) and males – 32(47.8%). All cases were to undergo the myringoplasty. Age mean ±SD were 21.93±9.47 years. Fifty (74.6%) patients had perforation in the right ear and seventeen (25.4%) – in the left ear (Table 1). Right and left ear perforations were not statistically significant (χ^2= 1.117 and p-value =0.290). None of the patients underwent both ear surgeries at the same time.

Table 1 – Characteristics of patients according to the perforations of the ear

N=67		Sex		Total	Test of differences	
		Female	Male		χ^2	p-value
Age mean±SD		22.9±9.6	20.7±9.3		t* 0.944	0.349
Perforated ear N (%)	Right	28(41.79)	22(32.83)	50(74.62)	1.117	0.290
	Left	7(10.44)	10(14.92)	17(25.37)		
CSOM, N (%) (Chief complaint)	Hearing loss	21(31.34)	20(29.85)	41(61.19)	1.282	0.527
	Ear discharge	11(16.41)	7(10.44)	18(26.86)		
	Hearing loss +ear discharge	3(4.47)	5(7.46)	8(11.94)		
Total		35(52.2%)	32(47.8%)	67(100%)		

The mean age for females and males was 22.9±9.6and 20.7±9.3years respectively. Hearing loss was the most common problem in this study. Forty-one (61.2%) patient' chief complaint was hearing loss, while 18 (26.9%) patients experienced ear discharge as common complaint, and 8 (11.9%) patients had both hearing loss and ear discharge (figure1). Symptoms were not statistically significant (χ^2=1.282, p-value =0.527).

Most of the patients showed subtotal perforation (all quadrants) of 30 (44.77%), 2-3 quadrants, and single quadrant perforations were observed at 23(34.32%) and 14 (20.89%) patients respectively. Most of the patients – 37 (55.22%) had shown hearing loss between 26-40dB, 25(37.31) patients –between 41-55dB and 5(7.46) patients – 16-25dB. In categories 1, 2 and 3 between the perforation size and degree of hearing loss there was statistically significant association (χ^2=22.891, p<0.0001). (Table 2) In single quadrant and 2-3 quadrants perforations, most of the patients suffered from hearing loss between 26-40dB. In subtotal perforation most of the patients had hearing loss between 41dB and 55dB.

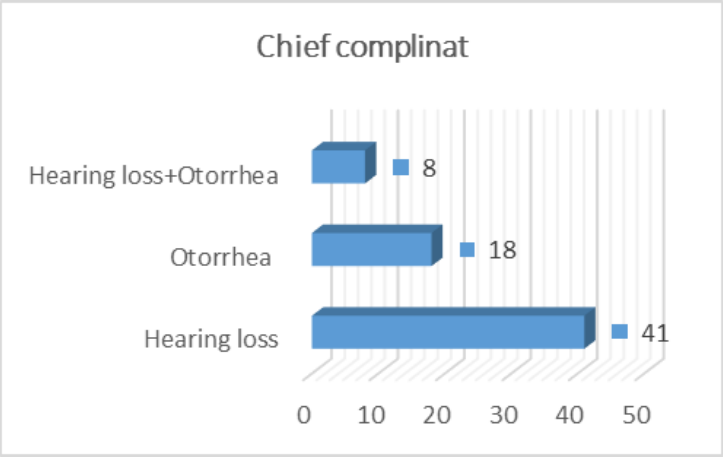

Figure 1 – Chief complaints of the patients

Table 2 – Hearing Impairment According to Perforation Size

		Perforation size			Total	χ^2	P-value
		1 quadrant	2-3 quadrants	Subtotal			
Hearing impairment (in dB, deci Bell) *	16-25dB	4(5.97%)	1(1.49%)	0(0%)	5(7.46%)	22.891	<0.0001
	26-40dB	10(14.92%)	15(22.38%)	12(17.91%)	37(55.22%)		
	41-55dB	0(0%)	7(10.44%)	18(26.86%)	25(37.31%)		
Total		14(20.89%)	23(34.32%)	30(44.77%)	67(100%)		

*According to the WHO classification of hearing impairment [10].

Out of 67 ears, 30 had subtotal perforation, in single quadrant perforation the post inferior quadrant average hearing loss was 29.97±4.32dB. In the anterior superior, anterior inferior, and posterior superior it was 20.06±2.1dB, 23.36±3.89dB, and 25.4±0.85dB respectively. In post sup combined with post inferior perforation, it was 37.42±9.59dB. For subtotal perforation, the hearing loss mean ±SD was 42.13±7. 07dB (figure 2). Between the location of perforation and hearing loss there was a statistically significant association (p=0.003).

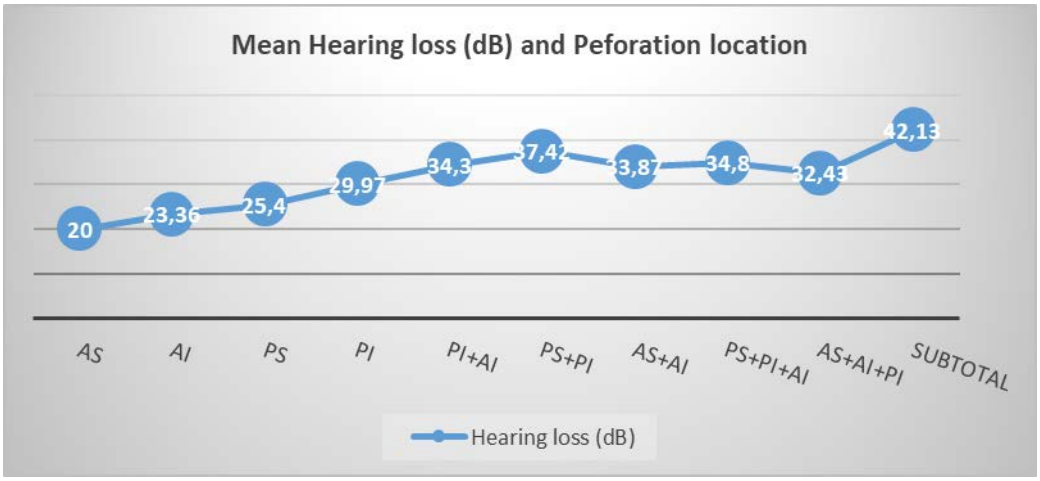

Figure 2 – Hearing loss and location of the perforation
AS=Anterior superior; AI=Anterior Inferior; PS=Posterior Superior; PI=Posterior Inferior;
PI+AI= Posterior Inferior with Anterior Inferior; PS+PI =Posterior Superior with Posterior Inferior;
AS+AI= Anterior Superior with Anterior Inferior; PS+PI+AS=Posterior superior and Posterior Inferior with Anterior inferior;
Anterior Superior and Ant Inferior with Post Inferior= AS+AI+PI.

Table 3 – Site of perforation according to the quadrants of the tympanic membrane

	Location of perforation in quadrant	No of cases	percentage	Hearing loss (dB) mean ±SD		Test of differences
1	Anterior superior	3	4.5	20.06±2.1		
2	Anterior inferior	5	7.5	23.36±3.89		
3	Posterior superior	3	4.5	25.4±0.85		
4	Posterior inferior	4	6.0	29.97±4.32		
5	Posterior inferior with Anterior inferior	4	6.0	34.3±7.09		
6	Posterior superior with Posterior inferior	5	7.5	37.42±9.59		
7	Anterior superior with Anterior inferior	5	7.5	33.87±5.73	F=3.248	P=0.003
8	Posterior superior and Posterior inferior With Anterior inferior	5	7.5	34.8±7.36		
9	Anterior superior and ant inferior with post inferior	3	4.5	32.43±7.67		
10	Subtotal (all quadrants)	30	44.8	42.13±7.07		
		67	100.0			

Table 3 site of perforation according to the quadrants of the tympanic membrane. All quadrants or subtotal perforation made up 30(44.77%) with 42.13±7.07 dB hearing loss, in single quadrant perforation the post inferior quadrant average hearing loss was 29.97±4.32dB; in the Anterior superior, Anterior inferior, and Posterior superior it was 20.06±2.1dB, 23.36±3.89dB, and 25.4±0.85dB respectively. In post sup combined with post inferior perforation, it was 37.42±9.59dB.

Discussion

The mean age of patients was 21.93 years, which points to a high disease burden in the younger age groups. Perforations of the tympanic membrane were linked to conductive hearing loss in varying degrees. The degree of conductive hearing loss was directly proportional to the extent of the perforation, the association was statistically significant (χ^2=22.891; p-value<0.0001). It is comparable with findings of other studies. Their findings matched our study findings showing that the larger perforation on the tympanic membrane is, the greater is the decibel loss in the sound perception [11-16].

The location of the tympanic membrane perforation was linked to the magnitude of hearing loss (one-way ANOVA: p-value = 0.003) as statistically significant. We found that hearing loss was more common in perforations involving the

posterior quadrants. According to many research finding, the location of the perforation has a direct effect on the severity of hearing loss [16-18]. In this study, mean hearing loss due to four quadrants or subtotal perforation was 42.13±7.07. Ant sup and post sup quadrants showed average hearing loss of 20.06±2.1 and 29.97±4.32 respectively. According to Bhusal et.al findings large perforations involving all four quadrants resulted in a hearing loss of 49 decibels, while those in the anterior quadrants showed hearing loss of at least 31 decibels [6]. A similar study showed a higher rate of hearing loss in the posterior perforations. There was observed a 29 dB hearing loss in the posterior perforations and an 18.5 dB hearing loss in the anterior perforations [11]. Mahajan et al. reported that the posterior-based perforations ($p \leq 0.05$) were found to show significant hearing loss [19]. A study conducted at the medical college of the Nepal noted that perforations involving the posterior inferior quadrant showed a 41–53 dB hearing loss in 100 cases [17]. According to the study the greatest hearing loss was linked to posterior perforations, which was 39.99±2.79 dB, followed by central perforations, 35.64±5.31 dB, and anterior perforations, 30.1 ±2.98 dB, respectively[20]. The study showed that postero-inferior perforations of equal size "average perforation size 7.76 mm^2" had a higher average hearing loss (40.07 dB) than antero-inferior ones , which had a lower average (29.30 dB) hearing loss [4].

However, numerous studies deny the impact of the perforation site on the degree of hearing loss [8,18,21] . Since the round window is directly exposed to sound, posterior quadrant perforations show worse hearing than anterior quadrant perforations [19].

Several further studies with a greater number of cases are required to link hearing loss and the location of the tympanic membrane perforation.

Conclusion

The degree of hearing loss increased statistically with increase of the size of perforation, the size of the tympanic membrane perforation has impact on hearing loss. Subtotal perforation causes greater degree of hearing loss. Hearing loss was significant, which was affected by the location of the perforation on the tympanic membrane. The degree of hearing loss was greater in posterior perforations.

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