Does Middle Ear Pathologies Have Relationship with Hearing Level in Chronic Suppurative Otitis Media?

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ÖZET

Kronik süpüratif otitis mediada işitme düzeyi ve orta kulak patolojisi arasında ilişki var mı?

Amaçlar: Kronik süpüratif otitis mediada (KSOM) orta kulak patolojilerini ve işitme kaybıyla ilişkisini belirlemek.
Materyal ve Metod: KSOM'lı 100 hasta değerlendirildi. Kulak zarı perforasyonları yeri ve tipine göre: anteriör santral, posterior santral, santral malleolar ve geniş santral olarak sınıflandırıldı. Kemikçik zincirin durumu; hareketli ve salim, disloke, tamamıyla yok, salim fakat fiske ve salim fakat hareketliliği kısıtlı olarak sınıflandırıldı.
Bulgular: Hastaların 6%'sında anteriör santral, 13%'ünde posteriör santral, 15%'inde santral malleolar, 48%'inde geniş santral ve 14%'ünde yalnızca retraksiyon cebi mevcuttu. Kemikçik zinciri salim ve hareketli olan olan hastaların kulak zarı perforasyonlarının yeri ve tipi ile ortalama işitme düzeyi arasında anlamlı bir ilişki mevcuttu. Kolesteatomlu KSOM'lı (KKSOM) hastaların sadece 3%'ünde salim ve hareketli kemikçik zincir, 75.8%'inde devamsız kemikçik zincir ve 12.1%'inde tamamıyla kayıp kemikçik zincir mevcuttu. Kolesteatomsuz KSOM'lı hastalarda malleus ve stapes en fonksiyonel kemikçikler ve inkus onları takip ediyor; fakat KKSOM'lı hastalarda stapes en fonksiyonel kemikçikti.
Sonuçlar: En fazla işitme kaybı, kolesteatom nedeniyle kemikçik zincirde devamsızlık oluşmasıyla açıklanabilen atik perforasyonlarında görüldü. Kulak zarı perforasyonlarının yeri ve büyüklüğü işitme düzeyini etkilemektedir.
Anahtar kelimeler: Süpüratif otitis media; kuulak zarı perforasyonu; saf ses odyometri; işitme kaybı

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ABSTRACT

Does middle ear pathologies have relationship with hearing level in chronic suppurative otitis media?

Objectives: To detect middle ear pathologies in chronic suppurative otitis media (CSOM) and the relationship with hearing loss.
Study Design and Methods: 100 patients with CSOM were evaluated. The site and type of perforation were classified as anterior central, posterior central, central malleolar and large central. Status of ossicular chain classified as intact and mobile, dislocated, totally absent, intact but fixed and intact but with limited movement.
Results: 6% of patients had anterior central, 13% posterior central, 15% central malleolar, 48% large central and 4% attic perforation but 14% had only retraction pouch . There was a significant relationship between average hearing level and type, site of tympanic membrane perforations in patients with intact and mobile ossicular chain. In patients with cholesteatomatous CSOM (CCSOM) only 3% of patients had intact and mobile ossicular chain, 75.8% discontinuous ossicular chain and 12.1% totally absent ossicules. Malleus and stapes were the most functional ossicles and incus follows them in noncholesteatomatous CSOM; but in CCSOM patients most fuctional ossicle was stapes.
Conclusions: The most hearing loss have seen in attic perforation which may be explained by disconnection at ossicular chain caused by cholesteatoma. The size and site of tympanic membrane perforation effects hearing level.
Key words: Otitis Media; Suppurative; Tympanic Membrane Perforation; Audiometry; Pure-Tone; Hearing Loss

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INTRODUCTION

Normal middle ear is composed of a tympanic membrane which takes sound vibrations, bones which transmits these vibrations to inner ear and an eustachian tube which balances air pressure in each side of tympanic membrane. Also middle ear transmits low empedance sound vibrations to high empedance cochlea which is full of fluid. Helmholtz described pressure transformation by elevation effect of tympanic membrane (Katanery Lever), lever effect of bones (Ossicular Lever) and hydraulic effect of the ratio between tympanic membrane area and oval window area (Hydraulic Lever). In the absence of these effects sound vibrations reach to cochlea with a loss of 30 db (1).

Perforation in tympanic membrane or defect in bones results in loss of phase difference between oval and round window. Both oval and round windows

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vibrates at the same time. With this mechanism two counter vibrations occurs in perilymph and nullifies themselves causing hearing loss. In this situation if one of the windows is protected, sound vibrations arrives to windows at different times and phase difference preserved. In type 4 tympanoplasty this mechanism can decrease hearing loss. If perforation in tympanic membrane or defect in bones is seen, it's important to protect the phase difference between windows for proper hearing (1).

Chronic suppurative otitis media (CSOM) is recurrent and progressive disease which is characterized with tympanic membrane perforation and suppurative discharge. It is defined as otitis media resistant to medical therapy and lasting more than three months. Degree of hearing loss depends on size and site of the perforation (2,3).

Marginal perforations have more predisposition to invasion of epidermis toward middle ear so resulting in much cholesteatoma formation than central perforations. But in a study it is showed that central perforations are not innocent as they thought and must be treated as attic or marginal perforation (4). Perforations at schrapnell membrane doesn't really effect hearing because this part of membrane doesn't contributes to vibration. Perforations at anterior quadrant of tympanic membrane effects hearing much more than inferior quadrant perforations. But posterior quadrant perforations effects hearing at a considerable amount because it's found in maximal amplitude region. If membrane across the round window is effected, protective function of tympanic membrane dissappears and causes much more hearing loss. Hearing loss type in patients with chronic suppurative otitis media is usually conductive but sometimes sensorineural or mixed type hearing loss can be seen. Sometimes hearing levels may be normal in attic perforation and cholesteatoma patients. In many patients with chronic suppurative otitis media sound vibrations can be conducted with cholesteatoma, granulation tissue, purulent secretions, fibrous bands and polips. In these patients postoperative air-bone gap may increase after removing of these tissues (5).

İn literature studies it was reported that there was high frequency hearing loss in 18% of patients with chronic suppurative otitis media and there was high frequency hearing loss in 1.6% of control patients (6). Also in another study it was mentioned that 37.5%-54.7% of patients with chronic suppurative otitis media had sensoryneural hearing loss (7). It is described as passage of toxic materials through semipermeable round window and causing progressive destruction of corti organ (6,7). Sensorineural hearing loss in chronic suppurative otitis media depends on duration of disease and seen frequently in elder patients (8,9).

As a result, hearing loss in chronic suppurative otitis media is a dynamic situation. We must frequently evaluate audiometric examinations in these patients before permanent and irreversible hearing loss occurs. In this study we aimed to detect middle ear pathologies in patients with chronic suppurative otitis media and demonstrate the relationship between these pathologies and hearing loss.

MATERIALS AND METHODS

In this study totally 100 patients (63 female, 37 male) were evaluated who took the diagnosis of chronic suppurative otitis media and operated in department of otorhinolaryngology at Haydarpaşa State Hospital for Research and Training between january 2003 and december 2007. We aimed to detect middle ear pathologies preoperatively and peroperatively in patients with chronic suppurative otitis media and demonstrate the relationship between these pathologies and hearing loss.

The preoperative examination included history taking and examination of the ears under microscope. Status of external auditory canal, characteristics of middle ear secretion, shape and site of perforation, cholesteatoma formation and ossicular chain status were noted. Audiometric assessment was performed by using a clinical audiometer calibrated according to International Organization for Standardization (ISO) standard in a sound proof room. A pure tone audiometry within one week prior to surgery was done at the frequencies of 250, 500, 1000, 2000, 4000 and

8000 Hz. Air and bone conduction thresholds were determined with appropriate masking technique whenever indicated. "Hearing level" was defined as the mean air conduction threshold at 500, 1000 and 2000 Hz and average of these frequencies were calculated to measure the hearing level. Preoperative examination findings were reconfirmed during surgery.

Hearing loss type of the patients were classified as conductive type hearing loss when bone conduction treshold is within normal levels and air conduction treshold is over 20 desibels; as sensorineural type hearing loss when air and bone conduction treshold is over than 20 desibels and air bone gap is lower than 10 desibels and lastly as mixed type hearing loss when air conduction treshold is over 20 desibels but air bone gap is larger than 10 desibels. When evaluating relationship between middle ear pathology and hearing loss we used air-bone gap and air conduction treshold.

The site and type of perforation were observed and classified as anterior central, posterior central, central malleolar and large central. We noted as large central perforation if the perforation involves all four quadrants in pars tensa but a little tympanic membrane remain is observed. The size of the perforation were estimated as small central (<%40 of total surface of tympanic membrane) and large central (>%40 of total surface of tympanic membrane). All the myringoplasties were done under general anesthesia, the incisions were preferred as postaural or endaural route. Patients who had perforation and secretion at attic region were noted as attic perforation. Also the patients who had tympanic membrane adhered to ossicular chain or promontorium and in which apex of the retraction pouch could not be seen were classified under retraction of tympanic membrane.

Status of ossicular chain classified as intact and mobile, dislocated, totally absent, intact but fixed and intact but with limited movement. If ossicular chain was functional classified as intact and mobile, if there was erosion at bones classified as discontinuous, if there was no ossicle classified as totally absent, if there was no movement at ossicular chain classified as intact but fixed and if there was minimal movement classified as intact but limited movement. Also each ossicle was classified as fuctional, absent, erosioned, fixed and limited movement. We obtained Institutional Review Board for this study.

We classified chronic suppurative otitis media as cholesteatomatous and noncholesteatomatous.

RESULTS

Mean age of 100 patients who participated to this study was 29.63±11.69. 63% of patients was female and 37% of patients was male.

There was no perforation in 14% of patients but microscopic examination revealed only retraction pouch. Also %6 of patients had anterior central, 13% of patients had posterior central, 15% of patients had central malleolar, 48% of patients had large central and 4% of patients had attic perforation (Table 1). 33% of operated patients had cholesteatomatous CSOM and 67% of operated patients had noncholesteatomatous CSOM.

There was a reverse proportion between increase in frequency level and air conduction treshold level. Highest air conduction treshold level was seen at 500 Hz frequency. Also there was higher air conduction treshold at the same frequency in patients with cholesteatomatous CSOM than patients with noncholesteatomatous CSOM (Table 2).

Average hearing level in cholesteatomatous CSOM patients is statistically significant higher than patients without cholesteatoma ($p<0.01$) (Table 3).

Retraction pouch (42.4%) took the first place in patients with cholesteatomatous CSOM. Also large central (30.3%) perforations, posterior central (15.2%) perforations and attic perforations (12.1%)

Table 1: Distribution of patients according to type and site of tympanic membrane perforation

Perforation type and localization	Number	%Ratio
No perforation (retraction pouch)	14	14,0
Anterior central	6	6,0
Posterior central	13	13,0
Central malleolar	15	15,0
Large central	48	48,0
Attic perforation	4	4,0

Table 2: Preoperative pure tone audiometric results

Frequency (Hz)	Cholesteatoma +			Cholesteatoma -		
	Air conduction treshold level(dB)	Bone conduction treshold level(dB)	Average air bone gap (dB)	Air conduction treshold level(dB)	Bone conduction treshold level(dB)	Average air bone gap (dB)
	Mean+SD	Mean+SD	Mean+SD	Mean+SD	Mean+SD	Mean+SD
500	60,45±11,68	16,51±12,71	43,94±12,61	51,04±12,89	20,82±8,86	30,22±9,02
1000	54,54±11,68	14,54±11,13	40,00±11,99	43,50±14,87	16,94±8,70	26,56±9,81
2000	49,24±13,05	15,30±12,24	33,94±11,64	38,95±14,23	16,34±9,48	22,61±9,35
4000	46,06±14,40	13,79±13,05	32,27±10,46	37,46±13,24	14,48±8,35	22,98±9,77
Average	54,75±11,20	15,45±11,50	39,29±10,76	44,50±13,45	18,03±8,27	26,46±8,54

Student t test used. **p<0.01

Table 3: Evaluation of average hearing level and air bone gap in patients with cholesteatomatous and noncholesteatomatous CSOM

	Cholesteatoma+ Mean+SD	Cholesteatoma- Mean+SD	p
Average Hearing Level(dB)	54,75±11,20	44,50±13,45	0,001**
Average Air Bone Gap	39,29±10,76	26,47±8,54	0,001**

Student t test used. ** p<0.01

followed retraction pouch. In noncholesteatomatous CSOM group most frequently large central (48%) perforation was seen. Following large central perforations central malleolar perforation (15%) was seen (Table 4). There was a statistically significant relationship between type and site of tympanic membrane perforation and average hearing level (p<0.01). Also there was a statistically significant relationship between type and site of tympanic membrane perforation and presence of cholesteatoma (p<0.01). Retraction pouch frequency in patients with cholesteatomatous CSOM (%42.4) was significantly higher than patients with noncholesteatomatous CSOM (%0). Central malleolar (%22.4) and large central (%56.7) perforation frequency in patients with noncholesteatomatous CSOM was significantly higher than patients with cholesteatomatous CSOM (Table 4).

In patients with cholesteatomatous CSOM there was a statistically significant relationship between type and site of tympanic membrane perforation and average hearing level (p<0.05). Average hearing level of posterior central perforations was significantly lower than average hearing level of

Table 4: Evaluation of type and site of tympanic membrane perforation and average hearing level in patients who were operated

	Type and Site of tympanic membrane perforation	Average Hearing Level (db) n	Mean±SD	Median	p
Cholesteatoma+	No perforation (retraction pouch)	14	53,69±12,98	55	0,027*
	Anterior central	-	-	-	
	Posterior central	5	45,00±8,57	48,3	
	Central malleolar	-	-	-	
	Large central	10	62,00±5,43	61,7	
	Attic perforation	4	52,50±8,77	55	
Cholesteatoma-	No perforation (retraction pouch)	-	-	-	0,001**
	Anterior central	6	20,55±4,30	20,8	
	Posterior central	8	49,58±6,22	47,5	
	Central malleolar	15	37,78±11,38	35	
	Large central	38	49,87±10,84	46,7	
	Attic perforation	-	-	-	

Kruskal Wallis Test is used. * p<0.05, ** p<0.01

Table 5: Evaluation of the relationship between average hearing level, average air bone gap and type and site of tympanic membrane perforations in patients with intact and mobile ossicular chain

	Type and Site of tympanic membrane perforation				+p
	Anterior Central (n=6)	Posterior Central (n=6)	Central Malleolar (n=11)	Large Central (n=27)	
	Mean±SD (Median)	Mean±SD (Median)	Mean±SD (Median)	Mean±SD (Median)	
Average hearing level	20,55±4,30 (20,8)	46,94±2,67 (45,8)	31,66±4,28 (33,3)	45,92±4,58 (46,6)	0,001**
Average air bone gap	13,33±2,98 (13,3)	27,77±2,72 (27,5)	19,69±3,56 (20)	25,98±3,24 (26,67)	0,001**

+Kruskal Wallis test. **p<0.01

Wilcoxon test was used when determining significance between groups

large central perforations (p:0.003; p<0.01). There was no statistically significant difference between average hearing level of other type and site tympanic membrane perforations (p>0.05) (Table 4).

In patients with noncholesteatomatous CSOM there was a statistically significant relationship between type and site of tympanic membrane perforation and average hearing level (p<0.01). Average hearing level of anterior central perforations was significantly lower than average hearing level of posterior central (p:0.002; p<0.01), central malleolar (p:0.002; p<0.01) and large central (p:0.001; p<0.01) perforations. Average hearing level of central malleolar perforations was significantly lower than average hearing level of posterior central (p:0.022; p<0.05) and large central (p:0.011; p<0.05) perforations. There is no statistically significant difference between average hearing level of other type and site tympanic membrane perforations (p>0.05) (Table 4).

There was a statistically significant relationship between average hearing level and type, site of tympanic membrane perforations in patients with intact and mobile ossicular chain (p:0.001; p<0.01). Average hearing level of central malleolar perforations was significantly lower than average hearing level of posterior central and large central perforations (p:0.001; p<0.01). There was no statistically significant difference between average hearing level of posterior central and large central perforations (p:0.480; p>0.05) (Table 5).

There was a statistically significant relationship between air bone gap and type, site of tympanic membrane perforations in patients with intact and mobile ossicular chain (p<0.01). Average air bone gap in anterior central perforations was significantly lower than average air bone gap of posterior central, central malleolar and large central perforations (p:0.001; p<0.01). Average air bone gap in central malleolar perforations was significantly lower than average air bone gap of posterior central and large central perforations (p:0.001; p<0.01). There was no statistically significant difference between average air bone gap of posterior central and large central perforations (p:0.278; p>0.05) (Table 5).

There was a statistically significant relationship

Table 6: Average air conduction treshold change in patients with tympanic membrane perforations and intact, mobile ossicular chain

	Average Air Conduction Treshold Mean±SD	$^{+}$p
500Hz average air conduction treshold	46,90±11,20	0,001**
1000Hz average air conduction treshold	38,40±11,31	
2000Hz average air conduction treshold	34,30±9,58	
4000Hz average air conduction treshold	32,70±7,77	
500-1000 $^{++}$p	0,001**	
500-2000 $^{++}$p	0,001**	
500-4000 $^{++}$p	0,001**	
1000-2000 $^{++}$p	0,001**	
1000-4000 $^{++}$p	0,001**	
2000-4000 $^{++}$p	0,001**	

+Variant analysis in repetitive measures

++Paired sample t test

**p<0.01

between 500Hz, 1000Hz, 2000Hz and 4000Hz average air conduction tresholds of tympanic membrane perforations in patients with intact and mobile ossicular chain (p<0.01). Increase in 500Hz average air conduction treshold in patients with intact and mobile ossicular chain when compared with 1000Hz, 2000Hz and 4000Hz average air conduction tresholds was statistically significant (p:0.001; p<0.01). Increase in 1000Hz average air conduction treshold in patients with intact and mobile ossicular chain when compared with 2000Hz(p:0.001; p<0.01) and 4000Hz(p:0.001; p<0.01) average air conduction tresholds was statistically significant. There was no statistically significant differance between average air conduction tresholds of 2000Hz and 4000Hz (p:0.070; p>0.05) (Table 6).

Totally in 51% of patients ossicular chain was intact and mobile. Only 13.4% of patients had discontinuous ossicular chain in patients with noncholesteatomatous CSOM. In patients with cholesteatomatous CSOM only 3% of patients had intact and mobile ossicular chain, 75.8% of patients had discontinuous ossicular chain and 12.1% of patients had totally absent ossicules. In patients without cholesteatoma 7.5% of them had intact but fixed ossicles and 4.5% of them had intact but limited movement. In patients with cholesteatoma 6.1% of them had intact but fixed ossicles and 3% of them had intact but limited movement. There was a statistically significant relationship between ossicular chain status and presence of cholesteatoma (p<0.01). Ratio of discontinuous ossicles in patients with cholesteatoma (%75.8) was significantly higher than patients without cholesteatoma (%13.4). Ratio of intact and mobile ossicles in patients without cholesteatoma (%74.6) was significantly higher than patients with cholesteatoma (%3). Discontinuous and totally absent ossicles in patients with cholesteatomatous CSOM (%87.9) was significantly higher than patients with noncholesteatomatous CSOM(%13.4). Also ratio of ossicles with intact but limited movement, intact and mobile and intact but fixed movement in patients without cholesteatoma (%86.6) was significantly higher than patients with cholesteatoma (%12.1) (Table 7).

Malleus and Stapes were the most functional (intact and mobile) ossicles found intraoperatively with a ratio of 88.1% and incus followed them with a ratio of 79.1% in patients with noncholesteatomatous CSOM. In CSOM patients with cholesteatoma most fuctional ossicle was found intraoperatively as stapes (36.4%) and it was followed by malleus (24.2%) and incus (6.1%) (Table 8).

Most erosioned ossicle in patients with noncholesteatomatous CSOM was found as incus (4.5%) but in patients with cholesteatomatous CSOM malleus took the first place with a ratio of 45.5%. Absence of incus was seen at 3% and 54.5% in patients with noncholesteatomatous and cholesteatomatous CSOM respectively (Table 8).

Incus was found as the most absent ossicle (54.5%) in patients with cholesteatomatous CSOM. Also stapes was absent in 48.5% of patients with cholesteatomatous CSOM (Table 8).

There was a statistically significant relationship between malleus status and presence of cholesteatoma (p<0.01). Erosion of malleus in patients with cholesteatomatous CSOM (45.5%) was significantly higher than patients with noncholesteatomatous CSOM (1.5%). Also the ratio of intact and mobile malleus in patients with noncholesteatomatous CSOM (88.1%) was significantly higher than patients

Table 7: Evaluation of ossicular chain status due to presence of cholesteatoma

Ossicular Chain Status	Cholesteatoma + n (%)	Cholesteatoma - n (%)	Total n (%)	p
Intact and mobile	1 (%3,0)	50 (%74,6)	51 (%51,0)	0,001**
Discontinuous	25 (%75,8)	9 (%13,4)	34 (%34,0)	
Totally absent	4 (%12,1)	0 (%0)	4 (%4,0)	
Intact but limited movement	1 (%3,0)	3 (%4,5)	4 (%4,0)	
Intact but fixed	2 (%6,1)	5 (%7,5)	7 (%7,0)	

Chi-square test is used. ** p<0.01

Table 8: Evaluation of malleus, incus and stapes status due to presence of cholesteatoma

		Cholesteatoma + n (%)	Cholesteatoma - n (%)	Total n (%)	p
Malleus	Functional	8 (%24,2)	59 (%88,1)	67 (%67,0)	0,001**
	Absent	8 (%24,2)	0 (%0)	8 (%8,0)	
	Erosioned	15 (%45,5)	1 (%1,5)	16 (%16,0)	
	Limited movement	0 (%0)	4 (%6,0)	4 (%4,0)	
	Fixed movement	2 (%6,1)	3 (%4,5)	5 (%5,0)	
Incus	Functional	2 (%6,1)	53 (%79,1)	55 (%55,0)	0,001**
	Absent	18 (%54,5)	2 (%3,00)	20 (%20,0)	
	Erosioned	10 (%30,3)	3 (%4,5)	13 (%13,0)	
	Limited movement	0 (%0)	5 (%7,5)	5 (%5,0)	
	Fixed movement	3 (%9,1)	4 (%6,0)	7 (%7,0)	
Stapes	Functional	12 (%36,4)	59 (%88,1)	71 (%71,0)	0,001**
	Absent	16 (%48,5)	1 (%1,5)	17 (%17,0)	
	Erosioned	2 (%6,1)	0 (%0)	2 (%2,0)	
	Limited movement	0 (%0)	3 (%4,5)	3 (%3,0)	
	Fixed movement	3 (%9,1)	4 (%6,0)	7 (%7,0)	

Chi-square test is used. **p<0.01

Table 9: Evaluation of preoperative average hearing level of operated patients and cholesteatoma presence

Average Hearing Level (dB)	Cholesteatoma + n (%)	Cholesteatoma - n (%)	Total n (%)	p
<30	0 (%0)	10 (%14,9)	10 (%14,9)	0,001**
30-50	9 (%27,3)	35 (%52,2)	44 (%44,0)	
50-70	21 (%63,6)	20 (%29,9)	41 (%41,0)	
≥70	3 (%9,1)	2 (%3,0)	5 (%5,0)	

Ki-kare test is used. **p<0.01

Table 10: Evaluation of preoperative hearing loss type of patient's who are operated and cholesteatoma presence

Hearing Loss Type	Cholesteatoma + n (%)	Cholesteatoma - n (%)	Total n (%)	p
Conductive Type	27 (%81,8)	53 (%79,1)	80 (%80,0)	0,325
Mixed Type	4 (%12,1)	13 (%19,4)	17 (%17,0)	
Sensoryneural Type	2 (%6,1)	1 (%1,5)	3 (%3,0)	

Chi--square test is used.

with cholesteatomatous CSOM (24.2%) (Table 8).

There was a statistically significant relationship between incus status and presence of cholesteatoma (p<0.01). Absence of incus in patients with cholesteatomatous CSOM (54.5%) was significantly higher than patients with noncholesteatomatous CSOM(3%). Also the ratio of intact and mobile incus in patients with noncholesteatomatous CSOM (79.1%) was significantly higher than patients with cholesteatomatous CSOM (6.1%) (Table 8).

There was a statistically significant relationship between stapes status and presence of cholesteatoma (p<0.01). Absence of stapes in patients with cholesteatomatous CSOM (48.5%) was significantly higher than patients with noncholesteatomatous CSOM(1.5%). Also the ratio of intact and mobile stapes in patients with noncholesteatomatous CSOM (88.1%) was significantly higher than patients with cholesteatomatous CSOM (36.4%) (Table 8).

There was a statistically significant relationship between average hearing level and cholesteatoma (p<0.01). Ratio of average hearing level between 50-70 db in cholesteatomatous CSOM (63.6%) was significantly higher than noncholesteatomatous CSOM (29.9%) (Table 9).

There was no statistically significant differance

Table 11: Evaluation of cholesteatoma presence and retraction pouch presence

Retraction Pouch	Cholesteatoma + n (%)	Cholesteatoma - n (%)	Total n (%)	p
+	18 (%54,5)	1 (%1,5)	19 (%19,0)	0,001**
-	15 (%45,5)	66 (%98,5)	81 (%81,0)	

Chi-square test is used. **p<0.01

Table 12: Average hearing level and average air bone gap in patients with tympanic membrane perforations and intact, mobile ossicular chain

	Perforation Size Small Central (n=23) Mean±SD	Large Central (n=27) Mean±SD	+p
Average hearing level	32,75±10,50	45,92±4,58	0,001**
Average air bone gap	20,14±6,17	25,99±3,24	0,001**

+ Student t test is used. **p<0.01

between cholesteatoma presence and hearing loss type (p>0.05). Most frequently seen hearing loss type in all CSOM was conductive type hearing loss (80%), following this mixed type hearing loss (17%) and lastly sensorineural type hearing loss (3%) (Table 10).

There was a statistically significant relationship between presence of cholesteatoma and retraction pouch (p<0.01). Retraction pouch frequency in patients with colesteatoma (%54.5) was statistically significantly higher than patients without colesteatoma (%1.5) (Table 11).

Average hearing level and average air bone gap of small central perforations in patients with intact and mobile ossicular chain was statistically significant lower than large central perforations (p<0.01) (Table 12).

STATISTICAL FINDINGS

SPSS (Statistical Package for Social Sciences) for Windows 15.0 program was used for statistical analysis. Data values were expressed as mean + standard deviation and Kruskal Wallis test and Mann Whitney U test were used for comparision of the quantitative data between three groups. Also Mann Whitney U and Student t test were used for comparision of parameters between two groups. For the qualitative data comparision Chi-Square test was used. Variant analysis and paired sample t test were used for repetative measures. Differences were considered significant when p<0.05.

DISCUSSION

CSOM is characterized with irreversible inflammatory changes in middle ear (10). Disease may be active with ongoing suppuration or may be inactive with sequels from previous infections (11). According to Schuknecht, important findings in CSOM are mucosa edema, tympanosclerosis and rarefaction osteitis in ossicles and mastoid bone (12). Schuknecht divided CSOM in two as active and recovered (13). In active state there is hypervascularization in mucosa and submucosa, acute and chronic inflammatory cells and ulcerations but recovered state is characterized with fibrosis and new bone formation. According to Friedman, 49% of patients have granulation tissue and 25% of patients have cholesteatoma in suppurative CSOM (14). Also Paparella has the same opinion with Friedman about efficacy of cholesteatoma in presentation and development of CSOM (15). In our study we detected 33 (33%) cholesteomatous CSOM in totally 100 patients. Ratio of cholesteatoma frequency in our patients corresponds with Friedman's findings.

Patients with CSOM usually apply to clinic with the symptoms of ear discharge and hearing loss. Hearing loss type in CSOM may be conductive, sensorineural or mixed (14). According to Paparella 43% of patients with CSOM have sensoryneural hearing loss more than 15 db and 16% of patients with CSOM have sensorineural hearing loss more than 30 db (6).

Paparella described this increased level by passing of toxic materials resulting from recurrent infections through round window which causing biochemical alterations at cochlea. In a literature study it is found that patients have higher average sensorineural hearing level in noncholesteatomatous CSOM than cholesteatomatous CSOM (7). In our study we detected that 80% of patients had conductive type hearing loss, 17% of patients had mixed type hearing loss and 3% of patients had sensorineural hearing loss. There was no statistically significant differance between cholesteatoma presence and hearing loss type ($p>0.05$) (Table 10).

Most of the conductive hearing loss in CSOM results from sequels of CSOM. These sequels are tympanic membrane perforation, discontinuous or fixed ossicular chain, tympanosclerosis and epithelial retraction. There is significant relationship between myringosclerosis and ossicular pathology, retraction and cholesteatoma, retraction and cholesterol granuloma, retraction and ossicular pathology, perforation and ossicular pathology (16). In our study we found that 86% of patients with CSOM have tympanic membrane perforation and 14% of patients have attic retraction pouch (Table 1).

Tympanic membrane perforation have adverse effect upon hearing level. Because of perforation, area of vibrating tympanic membrane decreases, also ratio between tympanic membrane area and oval window area decreases both causing hearing loss (1). Austin investigated about the effect of tympanic membrane perforation upon hearing level in the year of 1978 (2). In this study he found straight proportion between size of tympanic membrane perforation and hearing level. Bigger tympanic membrane perforation causes more hearing loss. Also hearing loss is more obvious at lower frequencies. Tympanic membrane perforations at pars flaccida have minor effect but perforations at posterior quadrant have great effect on hearing level. Postero-inferior perforations abolish the sound protection of the round window; hence they will cause more hearing loss than perforations in any other quadrant (1). In our study we detected 82% of central perforations in 100 patients. This ratio increases to 100% in noncholesteatomatous CSOM and decreases to 46.5% in cholesteatomatous CSOM. Most frequently seen perforation is large central (%48) perforation. This increased ratio may be described by development of middle ear pathology to an advanced stage. Other than large central perforations, central malleolar (15%) perforations takes the second place in noncholesteatomatous CSOM. In cholesteatomatous CSOM most frequently seen tympanic membrane pathology is attic retraction pouch (42.4%). Also 30.3% patients with cholesteatomatous CSOM have large central perforation.

Alterations at middle ear mucosa changes with stage of the disease. In active inflammatory stage thickened and hyperemic mucosa produces mucoid or mucopurulent secretions. During healing tympanosclerosis or formation of bony structures may be seeen. These bony formations may cause fixation at ossicular chain. Also necrosis, osteitis or osteogenesis may begin at the 7^{th} to 10^{th} day of inflammation. Many hypothesis such as enzymatic activity, pressure changes, prostaglandins, cell activity and partial pressure of gases is put forward for these alterations. In CSOM it can be detected alterations at 92% of ossicles. Also erosion of ossicles is one of the important results of CSOM. During reconstructive procedures it is important to know the status of the ossicular chain (10,17). Cholesteatoma is usually tought for the reason of erosion. But in histological studies it is proven that inflammatory process has more effect than cholesteatoma (17,18,19). Recent studies also showed that increased vascularization, enzymes, cellular activity (histiocyte, osteoclast, osteoblast) and prostaglandins have a bigger role upon erosion than direct pressure of cholesteatoma and anoxia (20). Usually necrosis is seen at long process of incus due to thrombosis of mucosal arteries that nourish incus. Later malleus and stapes necrosis is seen (3). Also fixation of ossicular chain is not an uncommon situation. Inflammatory process is accused for fixation. Increased formation of connective tissue due to inflammation and bony dusts scattered around ossicles during surgery may result fixation at malleus and incus. Tympanosclerosis and otosclerosis are the main reasons for fixation of stapes (20,21).

Average hearing level is about 50 dB if incus and stapes is removed. If incus and malleus is removed from ossicular chain average hearing level is about 40 db. But this situation is not valid for all patients. Even there is dislocation at ossicular chain fibrous connections, polips and cholesteatoma may take part in connection and average hearing level may be less than we tought. Average hearing level is more than 40 dB if ossicular chain is fixed (17).

Mayerhoff studied about postmortem histological findings of ossicles and found lesions in malleus (43.1%), incus (81.3%) and stapes (57.7%) (23). Also in study of Tos with 1100 patients, there are alterations at malleus (54%), incus (80%) and stapes (52%) (21). In our study we found macroscopically these ratio as malleus (33%), incus (45%) and stapes (29%) (Table 7,8). Differences between our findings and Tos and Mayerhoff's findings may be due to microscopic evaluation of ossicles by Tos and Mayerhoff and because we excluded minimal defects from our ratio if it didn't effect function of the ossicle.

Austin studied about 1151 patients who are operated with reconstruction surgery for incus defect and found malleus and stapedial lesions as 16% and 23.2% respectively (23). In our study we found similar results like Austin as malleus 16% (erosioned) and stapes 17% (absent)(Table 8).

Tos studied about 690 patients and found stapes 6.7% defective, 23.6% totally absent and 69.7% intact (20). In our study we found similar results like Tos as 29% nonfunctional stapes and 71% intact (Table 8).

In our study we found that 87.9% of patients with cholesteatomatous CSOM had nonfunctional ossicular chain. Of these 87.9% patients 75.8% had discontinuous ossicular chain and 12.1% had totally absent ossicles. These findings showed us that cholesteatoma plays an important role in bone destruction. But also 13.4% of patients with noncholesteatomatous CSOM had discontinuous ossicular chain which showed us that cholesteatoma is not the only factor that causes bone destruction (Table 8).

Austin studied about the impact of tympanic membrane perforations upon hearing level in year 1978 and he found that patients with tympanic membrane perforation smaller than 40% of total tympanic membrane had average 22 dB air bone gap and patients with tympanic membrane perforation larger than 65% of total tympanic membrane had average 28 db air bone gap (2). In our study we found similar results like Austin as average air-bone gap of small central perforations (23%) in patients with intact and mobile ossicular chain was 20.14-/+6.17 dB. Also large central perforations (27%) in our study in the same patient group showed an average air-bone gap of 25.99 dB which is similar with Austin's results (Table 12).

When we looked for average hearing results in patients with cholesteatomatous CSOM according to site of tympanic membrane perforation, large central perforations resulted in 61.7 dB average hearing loss. Also average hearing results of patients with noncholesteatomatous CSOM according to site of tympanic membrane perforation, posterior central and large central perforations resulted in 47.5 and 46.7 dB average hearing loss respectively.

In our study we found that posterior central perforations resulted in 45.8 dB average hearing level which was greater than anterior quadrant perforations (20.8 dB) and central malleolar perforations (33.3 dB). Reason for this situation seems to be that postero-inferior perforations abolish the sound protection of the round window; hence they will cause more hearing loss than perforations in any other quadrant.

In our study patients with intact and mobile ossicular chain and large central perforations (27 patients) has an average hearing level as 46.6 dB and statistically higher average hearing level than perforations at any other quadrant. These findings clearly shows us that bigger perforations causes more hearing loss and average hearing level has straight proportion with tympanic membrane perforation size.

There is attic retraction pouch (14%) and attic perforation (4%) in patients with CSOM and all of these patients had chlolesteatoma. These patients had an average hearing level of 55 dB. Reason for this increased hearing level may be described as

discontinuous ossicular chain in most of the patients resulting from cholesteatoma. Also there is no attic retraction pouch or attic perforation in patients with noncholesteatomatous CSOM (Table 4).

There is serious conductive type hearing loss in patients with tympanosclerosis. Hearing loss is caused by fixation of ossicular chain. We must think about tympanosclerosis in patients with central perforation but increased average hearing level and patients with severe mixed type hearing loss. Literature studies showed that tympanosclerosis effects bone conduction levels and results in mixed type hearing loss (24,25). In our study 11% of patients had intact ossicular chain but limited movement or fixed condition.

Usually hearing loss caused by adhesive otitis media is about 40 to 50 dB. Also in further phases of disease there is mixed type hearing loss characterized by much more bone conduction loss at higher frequencies. Hearing loss caused by erosion at lenticular process of incus is not very much. This is caused by adhesion of tympanic membrane directly to head of stapes and resume the conduction with this way. But in patients with cholesteatoma, active erosion of ossicles may cause greater hearing loss (1). In our study 14% of patients with cholesteatomatous CSOM has retraction in tympanic membrane which causes 55 dB average hearing loss (Table 4). This 55 dB average hearing level is statistically lower than patients with large central perforation in cholesteatomatous CSOM (61.7 dB). This result also shows us that even there is discontinuation at ossicular chain tympanic membrane adheres to stapes or oval window and resumes the conduction of sound waves.

In our study we found that average hearing level and average air-bone gap of patients with cholesteatomatous CSOM is 54.75-/+11.2 dB and 39.29-/+10.76dB respectively. Also we found that average hearing level and average air-bone gap of patients with noncholesteatomatous CSOM is 44.5-/+13.45dB and 26.47-/+8.54 dB respectively. Average hearing level in cholesteatomatous CSOM patients is statistically significant higher than patients without cholesteatoma ($p<0.01$) (Table 3).

CONCLUSION

We can draw various conclusions from preoperative and peroperative evaluation of 100 patients with chronic suppurative otitis media and operated at Haydarpasa Numune Research and Training Hospital Otorhinolaryngology clinic.

1. Conductive type hearing loss is the most frequently seen hearing loss type with the ratio of 80% and than follows mixed type(17%) and sensoryneural type(3%).
2. Totally 33% of patients have cholesteatomatous CSOM.
3. Large central perforation (48%) is the most commonly seen tympanic membrane perforation type among patients with CSOM. Central malleolar perforations (15%), attic retraction pouches (14%), posterior central perforations (13%), anterior perforations (6%) and attic perforations (4%) encountered respectively.
4. Most commonly seen tympanic membrane pathology is found in patients with cholesteatomatous CSOM as attic retraction pouch (42.4%) and large central perforations (30.3%) fills second place. This result shows us the destructive characteristic of cholesteatoma.
5. Large central perforations in patients with cholesteatomatous CSOM caused an average hearing level of 61.7 dB. Anterior central perforations in patients with noncholesteatomatous CSOM caused an average hearing level of 20.8 dB. These findings show us that size and site of tympanic membrane perforation effects hearing level.
6. Totally 51% of patients in the study have intact and mobile ossicular chain. But only 1% of patients with cholesteatomatous CSOM have intact and mobile ossicular chain. This result also shows us destructive characteristic of cholesteatoma. There is ossicular discontinuation at 34% of all the patients with CSOM and we didn't observe any totally absent ossicular chain in patients with noncholesteatomatous CSOM. In our study 7% of all the patients have intact but immobile ossicular chain and 4% of of all the patients have intact but with limited movements. These patients are

classified as tympanosclerosis.

7. Stapes is found as the most functional ossicle (71%) in patients with CSOM. Most eroded ossicle is found as incus (33%) peroperatively. Also incus is found as the mostly seen totally absent ossicle (20%) in patients with CSOM.
8. Average hearing level in patients with attic perforation is 55dB. This increased hearing level may be explained by disconnection at ossicular chain caused by cholesteatoma.

These finding show us that most of the patients in our study had conductive type hearing loss. Also we found statistically significant relationship between tympanic membrane perforation size, tympanic membrane perforation site, fixation or disconnection at ossicular chain and average hearing level.

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