

Research

Correlation of tympanomastoidectomy pathological findings with hearing loss in chronic suppurative otitis media patients

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ABSTRACT

Background: Patients with chronic suppurative otitis media (CSOM) often experience hearing loss (HL) from mild to very severe degrees. In addition, patients with CSOM often have intra-operative pathological findings. **Purpose:** To determine the correlation between intra-operative tympanomastoidectomy pathological findings and the type and degree of HL using pure tone audiogram images, in CSOM patients. **Method:** An analytic study used a cross-sectional design. This research was conducted in three hospitals in Medan from October 2021 to December 2021. The sample size was 37 patients who would undergo tympanomastoidectomy surgery. **Result:** The most common pathological finding was granulation in 36 patients (97.3%), and followed by sclerotic in 31 patients (83.8%). The average patients had more than 2 pathological findings. Most of patients (78.4%) had conductive HL, and majority had moderate degree of HL in 25 patients (67.6%). Based on type of HL, there were significant associations with several pathological findings, namely cholesteatoma ($p=0.003$), incomplete hearing bones ($p=0.009$), ossicular defects ($p=0.001$), and facial nerve defects ($p=0.009$). In terms of the number of pathological findings, there was a significant correlation with HL ($p=0.004$, $r=0.467$) and the degree of HL ($p=0.029$, $r=0.360$). **Conclusion:** There was a significant correlation between intra-operative pathologic findings with the type and degree of hearing loss.

Keywords: chronic suppurative otitis media, hearing loss, otology, tympanomastoidectomy

ABSTRAK

Latar belakang: Pasien dengan otitis media supuratif kronis (OMSK) sering mengalami gangguan pendengaran dari derajat ringan hingga sangat berat. Selain itu, pada pasien dengan OMSK sering didapatkan adanya temuan patologis intra-operatif. **Tujuan:** Untuk mengetahui hubungan temuan patologi timpanomastoidektomi intra-operatif dengan tipe dan derajat gangguan pendengaran, menggunakan gambaran pemeriksaan audiogram nada murni pada pasien OMSK. **Metode:** Penelitian analitik yang menggunakan desain potong lintang. Penelitian ini dilakukan di tiga rumah sakit di Medan mulai bulan Oktober 2021 hingga Desember 2021. Besar sampel adalah 37 pasien yang akan menjalani operasi timpanomastoidektomi. **Hasil:** Temuan patologis yang paling umum adalah granulasi pada 36 pasien (97,3%) dan diikuti sklerotik pada 31 pasien (83,8%). Rata-rata pasien memiliki lebih dari 2 temuan patologis. Sebagian besar pasien (78,4%) mengalami gangguan pendengaran konduktif, dan umumnya pasien mengalami gangguan pendengaran derajat sedang sebanyak 25 pasien (67,6%). Berdasarkan jenis gangguan pendengaran didapatkan hubungan bermakna dengan beberapa temuan patologis yaitu kolesteatoma ($p=0,003$), tulang pendengaran tidak lengkap ($p=0,009$), defek tulang pendengaran ($p=0,001$), dan defek nervus fasialis ($p=0,009$). Dalam hal jumlah temuan patologis, didapatkan korelasi yang signifikan dengan gangguan pendengaran ($p=0,004$, $r=0,467$) dan juga derajat gangguan pendengaran ($p=0,029$, $r=0,360$). **Kesimpulan:** Ditemukan korelasi yang signifikan antara temuan patologis intra-operatif dengan jenis dan derajat gangguan pendengaran.

Kata kunci: otitis media supuratif kronik, hilang pendengaran, otologi, timpanomastoidektomi

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INTRODUCTION

Chronic suppurative otitis media (CSOM) is a chronic infection of the mastoid cavity and middle ear for more than 6 weeks, with marked otorrhea and tympanic membrane perforation.¹ The global prevalence rate estimates the incidence of CSOM between 1% to 46%. An estimated 65 to 330 million people have a history of ear discharge, of which 60% have significant Hearing Loss (HL).^{2,3}

HL that occurs in patients with CSOM is in the form of conductive deafness. This happens because in the middle ear there is a decrease in air pressure, ossicular destruction, tympanic membrane perforation, the presence of fluid in the middle ear space, or the presence of cholesteatoma. At an advanced stage, the inflammation that occurs can affect the inner ear and cause disturbances in the sensorineural component.⁴ The existence of this tympanic membrane perforation will result in impaired sound transmission.⁵

On audiometric examination of CSOM patients, most of them were found to have very severe degree of deafness, approximately 37.5% in the ear that was operated on. The highest air bone gap was found between 41 - 60 dB in 55% of cases. The most ossicle chain remnants found during intra-operative were only the stapes base, 67.5%. The extent of damage was identified during surgery. Cholesteatoma was most commonly found in the tympanic cavity and mastoid cavity during intra-operative as much as 77.5%, followed by in the mastoid cavity (12.5%), and in the epitympanum (5%).⁶

Pure tone audiogram has an important role in estimating the severity of a HL which

describes the integrity of the tympano-ossicular system; and it was useful for surgeons in pre-operative planning, prior to surgery.^{2,7} Because HL is a complication that is often found in patients with CSOM, and this disorder often interferes with the patient's quality of life, the authors were interested in conducting research on the correlation between intra-operative tympanomastoidectomy pathological findings with the type and degree of HL based on pure tone audiogram images in CSOM patients.

METHOD

This study used a cross-sectional design. The subjects were 37 CSOM patients who underwent tympanomastoidectomy surgery in three hospitals in Medan from October 2021 to December 2021. Subjects were selected using consecutive sampling method.

The inclusion criteria were all CSOM patients who underwent tympanomastoidectomy surgery and were willing to participate. Exclusion criteria were patients who had a history of previous ear surgery on the ear to be assessed. The independent variables in this study were intra-operative tympanomastoidectomy pathological findings, consisted of: cholesteatoma, sclerotic, granulation, fixed ossicles, ossicular defects, incomplete ossicles, and facial nerve defects. Meanwhile, the dependent variable in this study was the degree and type of HL.

This study was using the same audiometric device and audiometrist. The sample size was determined by the formula:⁸

$$n = \left[\frac{Z\alpha\sqrt{Po(1-Po)} + Z\beta\sqrt{Pa(1-Pa)}}{Pa - Po} \right]^2$$

Note:

$Z\alpha$ = Type I error $\rightarrow 5\% = 1.96$

$Z\beta$ = Type II error $\rightarrow 20\% = 0.84$

Po = Proportion of conductive deafness in CSOM patients $49.98\% = 50\% \sim 0.5^8$

$Pa - Po$ = The difference in the proportion of conductive deafness from the research to be carried out with the proportion of conductive deafness in the previous study $25\% = 0.25$

$Pa - Po = 0.25 \Rightarrow Pa - 0.5 = 0.25 \Rightarrow Pa = 0.75$

$$n = \left[\frac{1,96\sqrt{0,5 \times 0,5} + 0,84\sqrt{0,75 \times 0,25}}{0,25} \right]^2$$

$n = 28.9 \sim 29$

Thus, the minimum number of research samples amounted to 29 participants.

The study began with data collection of patients with CSOM at the ENT-Head and Neck Surgery (ENT-HNS) Department in three hospitals in Medan who would undergo tympanomastoidectomy, and consented to participate in the research. Afterwards, audiology examination was taken according to the research examination technique. An evaluation of the audiogram result was carried out in accordance with the research concept; followed by a CT-scan of the mastoid. After completing the pre-operative examinations, a tympanomastoidectomy surgery was performed under a microscope by an ENT-HNS specialist in the field of Otology. The results of intra-operative tympanomastoidectomy pathological findings that were in accordance with the research concept were recorded, and observed in relation with the audiogram results. Finally, all collected data were analyzed.

The data obtained were then processed using the SPSS (Statistical Product and Service Solution) computer program and presented in tabular form. Afterwards, the data obtained were analyzed statistically and assessed for a significant correlation between intra-operative pathological findings with the degree and type of HL using pure tone audiogram images in CSOM patients by performing the Mann Whitney Test, Fisher's Exact, and Spearman correlation. The p value less than 0.05 was significant.

This study had been approved by the ethics commission of Faculty of Medicine Universitas Sumatera Utara with number 1255/KEP/2021.

RESULT

CSOM patients who did anamnesis amounted to 45 persons; out of them, it was found 2 patients came for revision of previous surgery, so they were excluded. Then, there were also 3 patients who refused to be the subject of the study, and 3 patients who did not come during the follow-up. Thus, the total subjects in this study were 37 participants.

Most of the research subjects were aged 16–25 years old (43.2%) , with male gender (56.8%) more than female (43.2%), and the highest number of educations was high school, amounting to 22 subjects (59.5%) (Table 1).

CSOM was dominated by the tubotympanic type as many as 29 patients (78.4%). The most common intra-operative pathological finding was granulation in 35 patients (97.3%) (Table 2).

Conductive deafness was the most common type of disorder in this study (78.4%), and the majority was moderate degree HL (67.6%) (Table 3).

Significant differences in the type of HL were found in the pathological findings in the form of cholesteatoma ($p=0.003$), incomplete ossicles ($p=0.009$), ossicular defects ($p=0.001$), and facial nerve defects ($p=0.009$) (Table 4, Table 5).

Positive correlation was found between the number of intra-operative pathological findings with the type and degree of HL with r values of 0.467, p -value of 0.004, and r -value of 0.360, p -value of 0.029 (Table 6).

Table 1. Demographic characteristics

Gender	N (%)
Male	21 (56.8)
Female	16 (43.2)
Age (years)	
5–15	4 (10.8)
16–25	16 (43.2)
26–35	6 (16.2)
36–45	4 (10.8)
46–55	4 (10.8)
56–65	3 (8.1)
Educational background	
Primary school	3 (8.1)
Junior high school	8 (21.6)
Senior high school	22 (59.5)
Bachelor degree	4 (10.8)

Table 2. Types of CSOM and intra-operative findings in CSOM patients

Types of CSOM	N (%)
Tubotympanic	29 (78.4)
Aticoantral	8 (21.6)
Intra-operative findings	
Sclerotic	31 (83.8)
Cholesteatoma	8 (21.6)
Granulation	36 (97.3)
Hearing bone defects	5 (13.5)
Incomplete ossicles	4 (10.8)
Fixed hearing bone	10 (27)
Facial nerve defect	2 (5.4)

Mean (SD): 2.60 (1.61)

Median (Min-Max): 2 (1-7)

Table 3. Types and degree of hearing loss

Types of hearing loss	N (%)
Conductive deafness	29 (78.4)
Mixed deafness	7 (18.9)
Normal	1 (2.7)
Total	37 (100)

Degree of hearing loss (dB)	
Normal (<25)	1 (2.7)
Mild (26–40)	8 (21.6)
Medium (41–55)	25 (67.6)
Moderate-Severe (56–70)	1 (2.7)
Severe (>90)	2 (5.4)
Total	37 (100)

Abbreviation: dB=decibels

Table 4. Correlation between intra-operative findings and type of hearing loss

Intra-operative findings	Types of hearing loss				<i>p value</i>
	Conductive deafness	Mixed	Normal	Total	
Cholesteatoma	3 (37.5%)	5 (62.5%)	0	8	0.003
Granulation	28 (77.8%)	7 (19.4%)	1 (2.8%)	36	0.601
Incomplete hearing bone	1 (25%)	3 (75%)	0	4	0.009
Fixed bone movement	6 (69%)	4 (40%)	0	10	0.126
Hearing bone defect	1 (20%)	4 (80%)	0	5	0.001
Sclerotic	23 (74.2%)	7 (22.6%)	1 (3.2%)	31	0.167
Facial nerve defect	0	2 (100%)	0	2	0.009

Noted: Values are n (%), $p < 0.05$ was accepted as statistically significant,

^a: *p-value* for Mann Whitney U Test

Table 5. Correlation between intra-operative findings and degree of hearing loss

Intra-operative findings	Degree of hearing loss			<i>p value</i>
	Normal Mild	Medium Severe	Total	
Cholesteatoma	1 (12.5%)	7 (87.5%)	8	0.649
Granulation	8 (22.2%)	28 (77.8%)	36	0.243
Incomplete hearing bone	0	4 (100%)	4	0.554
Fixed bone movement	2 (20%)	8 (80%)	10	1.00
Hearing bone defect	0	5 (100%)	5	0.307
Sclerotic	6 (19.4%)	25 (80.6%)	31	0.140
Facial nerve defect	0	2 (100%)	2	1.00

Note: Values are n (%), $p < 0.05$ was accepted as statistically significant.

^a: *p-value* for Fisher's Exact Test

Table 6. Correlation between the number of intra-operative tympanomastoidectomy pathological findings and type of hearing loss

			Types of hearing loss	Number of findings
<i>Spearman's rho</i>	Types of hearing loss	Correlation coefficient	1.00	0.467
		Significant (2-tailed)		0.004
		N	37	37
	Number of findings	Correlation coefficient	0.467	1.00
		Significant (2-tailed)	0.004	.
		N	37	37

DISCUSSION

In this study, intra-operative pathological findings had been noted starting from cholesteatoma, facial nerve defects, granulation, sclerotic, incomplete ossicles, fixed bone movement, and ossicular defects; and conductive, sensorineural, or mixed HL. From all these findings, an analysis was carried out to find whether there was a correlation between these findings and the type of HL.

There were significant differences on the types of HL in various intra-operative pathological findings i.e. facial nerve defects ($p=0.01$), ossicular defects ($p=0.01$), cholesteatoma ($p=0.003$), and incomplete ossicles ($p=0.009$). These results were in line with previous research conducted by Irwan et al.⁹ at Dr. Mohammad Hoesin Hospital, Palembang, that out of the 252 CSOM patients, most had mastoiditis with cholesteatoma (62.69%) and 14.28% with sclerotic lesions. The most common HL found in that study were conductive HL (49.98%), followed by sensorineural HL (6.34%).⁹ In other studies at the ENT clinic of Government Medical College (GMC) in Amritsar, India, out of 100 CSOM patients accompanied by pathological findings, it was found conductive HL (81%) and mixed HL (19%).¹⁰ More than 50% of CSOM cases had mild to moderate conductive HL. This could occur caused by damage to the tympanic membrane and ossicles (conductive), or damage to the hair cells as a result of bacterial invasion that entered the inner ear (sensorineural), or both (mixed).⁶

Due to the disruption of the ossicles in the middle ear by osteomyelitic erosion and the tympanic membrane perforation, sound vibrations enter through the perforation tympanic and vibrate the foramen rotundum and ovale. In theory, when the cochlea is still intact, the resulting HL is about 30 dB, but could reach a maximum of 60 dB. A higher degree of hearing loss could occur if the

cochlea or auditory nerves are infected (acute labyrinthitis, meningitis, et cetera).⁶

The results obtained from bivariate analysis using Fisher's Exact test revealed that in this study there was no significant correlation between intra-operative pathological findings in patients with CSOM and the degree of HL. When viewed from the frequency distribution, intra-operative pathological findings were mostly in moderate to severe HL. These results indicated that intra-operative pathological findings could give prediction of the severity of HL in CSOM patients, but did not have a significant correlation.

This was in line with previous study which found that intra-operative pathological findings in the form of granulation tissue, cholesteatoma, and erosion even to the point of breaking the ossicular chain, were often found in malignant CSOM; where in malignant CSOM the highest proportion of HL degree was severe, followed by moderate to severe HL. Meanwhile, in tubotympanic CSOM, moderate HL was the most common, followed by mild HL.¹¹

Different results were found in other studies which shown that 25 (86.2%) patients had severe and very severe HL, and 28 (50%) patients had mild to moderate HL in CSOM with cholesteatoma.¹² One of the etiologies that determined the degree of HL was the presence of ossicles disorders in the middle ear, which could be occurred in CSOM.

Besides, there were many other factors that could affect the degree of HL, especially in the middle ear, including perforation, trauma, infection, middle ear masses, fixed ossicles, the presence of fluid in the middle ear cavity, and Eustachian tube obstruction.¹³

In this study, there were several limitations. The number of CSOM patients with tubotympanic and aticoantral disorders who had hearing disturbances were different, so the results might not be accurate to see the correlation between those two disorders.

There was no post-operative evaluation of tympanomastoidectomy to assess the success of the surgery in improving hearing function in CSOM patients.

In conclusion, there were significant differences in the types of HL in various pathological findings in the form of cholesteatoma, incomplete ossicles, ossicular defects, and facial nerve defects.

DISCLOSURE

The authors reported no conflicts of interest in this work.

REFERENCE

- Gustada S, Hafil AF. Otitis Media Supuratif Kronis. In: Liwang F, Yuswar PW, Wijaya E, Sanjaya NP (eds). *Kapita Selektta Kedokteran*. 5th ed. Depok: Media Aesculapius; 2020.
- Muftah S, Mackenzie I, Brabin B, Faragher B. Prevalence of Chronic Suppurative Otitis Media (CSOM) and Associated Hearing Impairment Among School-aged Children in Yemen. *Oman Med J*. 2015;30(5):358-365. doi:10.5001/omj.2015.72.
- Nainggolan ADP, Balatif R. Karakteristik Pasien Otitis Media Supuratif Kronik di RSUP Haji Adam Malik Medan. *Majalah Kedokteran Andalas*. 2021;44(3):148-153.
- Anggraeni R, Carosone-Link P, Djelantik B, Setiawan EP, Hartanto WW, Ghanie A, et al. Otitis media related hearing loss in Indonesian school children. *Int J Pediatric Otorhinolaryngol*. 2019Oct;125:44-50. doi: 10.1016/j.ijporl.2019.06.019.
- Laisitawati A, Suciati T, Ghanie A. Hubungan Otitis Media Supuratif Kronik dengan Derajat Gangguan Pendengaran di Departemen THT - KL RSUP Dr.Mohammad Hoesin Palembang Periode 2014-2015. *Majalah Kedokteran Sriwijaya*. 2017;49(2). doi: 10.36706/mks.v49i2.8371.
- Wilsen W, Satria D, Ghanie A, Doris MY. Gambaran Audiologi dan Temuan Intraoperatif Otitis Media Supuratif Kronik Dengan Kolesteatoma pada Anak. *Majalah Kedokteran Sriwijaya*. 2014;46(2). doi: 10.36706/mks.v46i2.2693.
- Shariff EA. Analysis of Hearing Loss by Pure Tone Audiometry in Patients with Chronic Suppurative Otitis Media. *Natl J Physiol Pharm Pharmacol*. 2019;9(6).
- Dahlan MS. Besar sampel dalam penelitian kedokteran dan kesehatan. Jakarta: *Epidemiologi Indonesia*; 2016, pp. 109-139.
- Irwan AG, Suyanti, Gunawan A, Widyasari F. Pre and Intraoperative Findings of Chronic Otitis Media. *IOP Conf. Series: J Phys*. 2019;1246:012019. doi: 10.1088/1742-6596/1246/1/012019.
- Kaur R, Singh J, Singh SP. A Study of Determinants of Sensorineural Hearing Loss in Chronic Suppurative Otitis Media with or without Cholesteatoma. *Int J Otolaryngol Head & Surg*. 2018;7:148-159. doi: 10.4236/ijohs.2018.74018.
- Tshering P, Chowdhury MA, Saha KL, Joarder AH. Clinicopathological study on CSOM: a comparison between tubotympanic and atticointral variety. *Bangladesh J Otorhinolaryngol*. 2012;18(2). doi: 10.3329/bjo.v18i2.11991.
- Samosir I, Naftali Z, Suprihati. Hubungan Kolesteatoma dengan Jenis dan Derajat Kurang Pendengaran pada Pasien Otitis Media Supuratif Kronik. *Jurnal Kedokteran Diponegoro*. 2018;7(2):562-73. doi: 10.14710/dmj.v7i2.20701.
- Dhingra P. *Disease of Ear, Nose and Throat, Head and Neck Surgery*. 7th ed. Philadelphia: Elsevier; 2018.