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Comparison of Germ Patterns between Cholesteatom Tissue and Tympanic Cavum Mucosa Tissue in COSM with Cholesteatom at Dr. Mohammad Hoesin Hospital, Palembang

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Abstract

Chronic Suppurative Otitis Media (CSOM) is middle ear inflammation due to infection characterized by otorrhea through perforation of the tympanic membrane that occurs for more than three months. Identifying bacterial patterns in CSOM is essential for managing CSOM patients with cholesteatoma. Proper administration of antibiotics is crucial to overcome infection and prevent widespread resistance. To compare the germ patterns between cholesteatoma tissue and tympanic cavum mucosal tissue in CSOM patients with cholesteatoma. This observational study has a cross-sectional design, and data collection was carried out using primary data taken from 27 CSOM patients with cholesteatoma who underwent mastoidectomy surgery with a total of 54 research samples taken from the examination of cholesteatoma tissue swabs and tympanic cavum mucosal tissue from August to October 2023. From the reliability coefficient between the two tissues using the Cohen's Kappa technique, there is a significant concordance in the germ pattern between the tympanic cavum mucosa tissue and the tympanic cavum mucosa of 0.580 (Moderate) $p<0.005$, with Pseudomonas aeruginosa, Proteus mirabilis and Klebsiella pneumoniae with a significance value of 0.656 (Good) $p<0.001$. There is a significant concordance in the germ pattern between cholesteatoma tissue and tympanic cavum mucosa tissue in CSOM cases with cholesteatoma. The most common bacteria in both tissues are Gram-negative, namely Pseudomonas aeruginosa, proteus mirabilis, and Klebsiella pneumoniae.

Keywords: CSOM with Cholesteatoma, Germ Pattern, Bacterial Culture

1. Introduction

Chronic Suppurative Otitis Media (CSOM) is a common chronic infectious disease worldwide, especially in developing countries. WHO estimates that by 2018, around 486 million people worldwide will be deaf, including 34 million children. A study in Indonesia in 2007 reported 4.2% of hearing loss and deafness cases, with an incidence of hearing loss due to CSO of 3.6%. Research in Palembang in 2021 showed that out of 102 subjects with CSOM, 85.3% had Unilateral CSOM and 14.7% had bilateral CSOM.[1-5]

CSOM is divided into with and without cholesteatoma based on the inflammatory process, perforation of the tympanic membrane, and cholesteatoma. Cholesteatomes are epithelial cysts that can damage the bone. Factors such as the anatomy of the Eustachian tube, the presence of cholesteatoma, environment, immune system, and genetics influence the occurrence of CSOM. Symptoms and complications of CSOM are related to the type of bacteria.[6-10] This study aims to compare the germ pattern between cholesteatoma tissue and tympanic cavum mucosa tissue in patients with chronic suppurative otitis media.

2. Methods

2.1. Research Design, Population, and Sample

An observational study was conducted at Dr Mohammad Hoesin Hospital Palembang. Sampling was done by consecutive sampling from August to October 2023.

The study involved 52 patients with cholesteatoma who underwent mastoidectomy at Dr. Mohammad Hoesin General Hospital Palembang, fulfilling the inclusion criteria as patients with cholesteatoma who underwent mastoidectomy at Dr. Mohammad Hoesin General Hospital Palembang during August-October 2023 and willing to participate and sign informed consent.

2.2. How it works

Demographic interviews were conducted before obtaining informed consent from patients for intraoperative sample collection at the Central Surgical Installation of Dr Mohammad Hoesin Hospital Palembang. Tissue samples were sent to the Central Laboratory of Dr Mohammad Hoesin Hospital Palembang for germ pattern analysis. Data that were incomplete or did not fulfill the exclusion criteria were excluded.

2.3. Data Collection

Data were obtained from patients who underwent mastoidectomy surgery at the Central Surgical Installation of Dr Moh. Hoesin Hospital Palembang and culture samples were obtained from the Central Laboratory Installatio and the study samples met the inclusion and exclusion criteria. The data obtained were qualitative and quantitative data. Data will be recorded in the research form.

2.4. Statistical Analysis

Univariate analysis was conducted for the characteristics of the study subjects, with numerical data presented as mean and standard deviation, as well as categorical data in graphs and distribution tables. Bivariate analysis used Cohen's Kappa Inter-rater Reliability test on CSOM patients. The analysis results are presented in tables, charts, and narratives with data processing using SPSS for Windows version 26.0.

3. Results

3.1. Characteristics of Research Subjects

Of the initial 34 patients, 6 dropped out because no bacteria grew and 1 only grew mould. The remaining 27 patients were aged 19-60 years (70.4%), with more males (60.7%) than females (39.3%). The most common cholesteatoma stage was stage 4, with 15 patients (55.6%) (table 1).

Table 1. Characteristics of research subjects (N=28)

Characteristics	Total (%)
Ages	
0-18 years old	5 (18,5)
19-60 years old	19 (70,4)
Above 60 years old	3 (11,1)
Gender	
Man	16 (60,7)
Woman	11 (39,3)
Cholesteatoma stage	
Stage 2	2 (7,4)
Stage 3	3 (11,1)
Stage 4	15 (55,6)
Stage 5	7 (25,9)

3.2. Germ Pattern Characteristics in CSOM with Cholesteatoma

The germ pattern consisted of 27 types of bacteria in 54 samples, with 11 Gram-positive species and 16 Gram-negative species. Gram-negative bacteria were found in 66.7% of tympanic cavum mucosa samples and 85.2% of cholesteatome samples. A total of 74.1% of samples showed the same culture at both sites, and 81.5% showed concordant culture results between the two sites (tabel 2).

3.3. Germ Pattern Distribution in CSOM with Cholesteatomes According to Tissue Predilection

Pseudomonas aeruginosa was most prevalent in cholesteatomes (59.3%), followed by Proteus mirabilis (11.1%) and Staphylococcus warneri (7.4%). In the tympanic cavum mucosa, Pseudomonas

aeruginosa predominated (37.0%), followed by Staphylococcus aureus (14.8%) and Proteus mirabilis (11.1%) (table 3).

Table 2. Compatibility of culture results with germ predilection

Compatibility	Total (%)
By Species	
Appropriate	20 (74,1)
Not Appropriate	7 (25,9)
Based on grouping (Gram negative and Gram positive)	
Appropriate	22 (81,5)
Not Appropriate	5 (18,5)

3.4. Group Conformity of Cultured Species in Both Tissues

Of the 27 patients, 22 (81.5%) had a concordant germ pattern between the cholesteatoma tissue and tympanic cavity mucosa. Gram-negative germs were predominant in 66.7% of patients, while 14.8% showed Gram-positive germs at both sites. The Cohen's Kappa test showed a germ pattern concordance between the two tissues of 0.580 (Moderate) with a significance of $p < 0.05$, where Gram-negative germs predominated (table 4).

3.5. Suitability of Cultured Species in Both Tissues

The results of the reliability coefficient between the two tissues using the Cohen's Kappa technique showed that there was a strong agreement (0.675) with a significance level of $p<0.01$ between the culture results in the tympanic cavum mucosa tissue and the cholesteatoma tissue. The dominant germ pattern was Pseudomonas aeruginosa.

4. Discussion

This study involved 34 subjects with 27 bacteria growing. Of the 27 samples tested, 11 types of bacteria grew on the mucosal tissue of the tympanic cavum and 9 types of bacteria grew on the cholesteatom tissue. The mean age of the patients was 16.17 ± 44.77 years, with 70.4% aged 19-60 years. There were more males than females, with a ratio of 1.5:1.

Table 3. Predilection characteristics of breeding results

Etiology	Total (%)
From the Mucosa of the Tympanic Cavum	
Pseudomonas aeruginosa	10 (37,0)
Staphylococcus aureus	4 (14.8)
Proteus mirabilis	3 (11,1)
Klebsiella pneumoniae	2 (7.4)
Staphylococcus epidermidis	2 (7.4)
Staphylococcus warneri	1 (3.7)
Citrobacter koseri	1 (3.7)
Staphylococcus haemolyticus	1 (3.7)
Staphylococcus paucimobilis	1 (3.7)
Acinetobacter lwoffii	1 (3.7)
Achromobacter xylosoxidans	1 (3.7)
From Cholesteatoma	
Pseudomonas aeruginosa	16 (59,3)
Proteus mirabilis	3 (11,1)
Staphylococcus warneri	2 (7.4)
Klebsiella pneumoniae	1 (3.7)
Citrobacter koseri	1 (3.7)
Staphylococcus haemolyticus	1 (3.7)
Staphylococcus paucimobilis	1 (3.7)
Achromobacter xylosoxidans	1 (3.7)
Staphylococcus epidermidis	1 (3.7)

Table 4. Species group conformity of second tissue culture results

	Cholesteatoma Tissue						value	asym p
	Gram-negative		Gram-positive		Total			
	n	%	n	%	n	%		
Gram-negative	18	66,7	0	0	18	66,7	0,580	0,158
Gram-positive	5	18,5	4	14,8	9	33,3		

This study is slightly different from previous studies that showed more female patients, with a percentage of 57.2% and an age of 10-56 years.[11-15] Chronic Suppurative Otitis Media (CSM) can occur in all age groups, including children, due to upper respiratory tract infections and different tubal structures. Smoking habit in males may be a risk factor for recurrent upper respiratory tract

infections.[4,16-17]

This study shows the distribution of cholesteatoma degree with the most stage groups in stage 4 (55.6%), followed by stage 2 (7.4%), stage 3 (11.1%), and stage 5 (25.9%). Previous studies have shown that the degree of invasion of cholesteatoma is mostly in stage 2 (28.57%) and stage 3 (71.43%). The analysis showed the relationship between the degree of cholesteatome invasion and auditory bone damage was 75.2%. Delay in treatment, incorrect use of ear drops, and lack of education on CSOM with cholesteatoma can cause complications. The success of mastoidectomy surgery is influenced by operator skill, surgical technique, post-surgical care, and counselling to the patient or family.[18-22] Good post-surgery care is essential to ensure that the healing process goes smoothly, the ear cleaning mechanism works properly, and to prevent infection.[16,23-24]

The study found a higher occurrence of single bacterial growth (78%) compared to polymicrobial infections (22%), in line with previous research showing a predominance of monomicrobial isolates. Pseudomonas aeruginosa, a Gram-negative bacterium, was the most prevalent pathogen in both tympanic cavity mucosal tissue (35.7%) and cholesteatoma tissue (57.1%). Additionally, Staphylococcus aureus, Proteus mirabilis, and Klebsiella pneumoniae were notable bacterial species. Analysis of cholesteatoma microbiota revealed the presence of Staphylococcus, Actinobacteria (including Corynebacterium), Brevibacterium, and Cutibacterium. The higher prevalence of Gram-negative bacteria in cholesteatoma tissue may contribute to tissue damage through the secretion of toxins and destructive enzymes.[4,25-26]

Table 5. Species suitability of second tissue culture results

		Cholesteatoma								
		Ps. aeruginosa	Staph. warneri	Proteus mirabilis	Citro .koseri	Staph. haemolyticus	Sphmon. paucimobilis	K.pneum.pneumoniae	Achro. xylosoxidans	Staph. epidermidis
Mucosa Tympanic cavum	Ps.aeruginosa	10	0	0	0	0	0	0	0	0
	Staph.warneri	0	1	0	0	0	0	0	0	0
	Staph.aureus	3	0	1	0	0	0	0	0	0
	Proteus mirabilis	1	0	2	0	0	0	0	0	0
	Citro.koseri	0	0	0	1	0	0	0	0	0
	Staph.haemolyticus	0	0	0	0	1	0	0	0	0
	Sphmon.paucimobilis	0	0	0	0	0	1	0	0	0
	K.pneum.pneumoniae	0	0	0	0	0	0	2	0	0
	Aci.lwoffii	1	0	0	0	0	0	0	0	0
	Achro.xylosoxidans	0	0	0	0	0	0	0	1	0
	Staph.epidermidis	1	0	0	0	0	0	0	0	1

The study found unique bacteria like Staphylococcus aureus and Acinetobacter lwoffii in the tympanic cavity mucosa. Gram-negative bacteria, including Pseudomonas aeruginosa, Proteus mirabilis, and Klebsiella pneumoniae, were prevalent in both cholesteatoma tissue and mucosa. There was a significant link between bacterial profiles in cholesteatoma tissue and middle ear mucosa. Understanding these germ patterns could aid in managing patients with chronic suppurative otitis media and cholesteatoma, especially concerning Gram-negative bacteria. Study limitations may have influenced results, and environmental factors like air temperature variations could impact bacterial growth outcomes.[27-28]

5. Conclusion

Pseudomonas aeruginosa was

predominant in tympanic tissue and cholesteatoma. Antibiotics were recommended according to the cholesteatom culture results. Need departmental cooperation for postoperative antibiotics policy.

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