

## Bacteriological Study Of Chronic Suppurative Otitis Media

Ammar Adnan Hadi (MBCHB)<sup>1</sup>, Ammar Hadi Khammas (FICMS)<sup>2</sup> and Wissam Mahdi Abbas Alsaed (PhD)<sup>3</sup>

### Abstract

**Background:** Chronic suppurative otitis media is a destructive disease of middle ear cleft that can progress rapidly. Medical treatment which depend on proper antibiotic selected from culture and sensitivity were prescribed, otherwise process goes to intra or extracranial complication.

**Objective:** Relation of certain clinical features to each isolated bacteria. The types of bacteria in chronic suppurative otitis media. Drug sensitivity for each isolated bacteria.

**Patients and Methods:** Forty-six patients enrolled in the current study, 41 patients have unilaterally discharged ears and 5 bilaterally discharged ears. The total ears are 51 ears were taken for examination, microorganism isolation, biochemical tests and then culture and sensitivity tests. Regarding ear examination, it involved clinical picture. Regarding laboratory tests certain types of biochemical test, 4 types of media were used for isolation of bacteria and in culture and sensitivity tests. 16 types of drugs used for culture and sensitivity test. All collected data putted in a questionnaire, tables and histograms.

**Results:** 55% of patients with profuse discharge while 45% scanty amount of ears discharge. Mucosal type of chronic suppurative otitis media were 53% while 47% of squamous type. Regarding types of bacteria, *Pseudomonas aeruginosa* of 41.2%, *Staphylococcus aureus* of 11.6% are the most common isolated bacteria. Regarding drug sensitivity, Imipenem, Meropenem of 100% sensitivity, Amikacin of 92% sensitivity while Cefixime of 62% resistance.

**Conclusion:** There was a relation between particular suppurative chronic otitis media causing microorganisms and specific discharge. *Pseudomonas aeruginosa* and *Staphylococcus* respectively are the most common pathogens. Imipenem and Meropenem are the most effective drugs

**Keywords:** Ear infection, Microbiology, Culture and sensitivity

**Corresponding Author:** ammmar79@yahoo.com

**Received:** 20<sup>th</sup> September 2020

**Accepted:** 22<sup>th</sup> September 2020

**DOI:** <https://doi.org/10.26505/DJM.19015680920>

<sup>1</sup> Al-Yarmouk Teaching Center. ENT -Baghdad- Iraq

<sup>2,3</sup> Collage of Medicine-AL-Mustansiriya University-Baghdad- Iraq

## Introduction

Chronic Suppurative Otitis Media (CSOM): Is defined as a continuous and enduring inflammation and infection of middle ear cleft and mastoid air cells for more than 6 weeks [1]. The duration of otorrhea for classifying chronic suppurative otitis media has been the subject of discussion among Otorhinolaryngologists with period ranging between 3 weeks to 3 months [2] while WHO recommended the period of 2 weeks duration [3,4].

It's characterized by its destructive disease of middle ear. Symptoms and signs of illness include tympanic membrane perforation, discharge from the ear, eroding of ossicles, bony walls of tympanic cavity, and hearing impairment [5]. The most common aerobic bacteria causing chronic suppurative otitis media include *Pseudomonas aeruginosa* and *Staphylococcus aureus*. It can be caused by anaerobic bacteria like *Bacteroides fragilis* and *Peptostreptococcus* [6].

## Patients and Methods

This study is a hospital-based cross-sectional study carried out at the ENT outpatient clinic and the Microbiology department of Al-Yarmouk teaching hospital between February 2019 and October 2019.

After the institutional review board approval. The sample comprised of forty six patients equal or above 10 years old and both genders with unilateral or bilateral active chronic suppurative otitis media who met the inclusion criteria. All patients were evaluated through a detailed history and clinical examination after getting consent from them or their relatives. Discharge from draining

ears were collected by sterilized ear swabs. The swabs were sent for microbiological analysis.

**Inclusion criteria:** Patients equal or above 10 years old of both gender with actively draining ears for more than 3 weeks whom consented or their relative have been consented to participate in the study. We choose this age group depending on the age of the patients that visit the outpatient clinic of the hospital.

### Exclusion criteria:

- 1- Patients on antibiotics (ear drops or systemic) within the past 3 days who's going to culture and sensitivity test.
- 2- Patients with discharging ears of less than 3 weeks duration.
- 3- Immunocompromised patients with chronic illness like Diabetes mellitus, organ transplant or on immunosuppressive drugs.
- 4- Patients who refused to consent to participate in this study.

### Ethical consideration:

- 1- The study has been carried out after approval by the Iraqi Board for Medical Specializations.
- 2- Patients have been included after taking consent.

### A- Clinical examination:

Complete history from each patient was taken and physical examination was done. Full examination of both ears including standard otoscope, endoscope and/or microscope.

General ENT examination was done. Regarding clinical picture of the disease and

as there are many symptoms and signs related to chronic suppurative otitis media we were taking the aural discharge as the main clinical feature of our current study. The aural discharge (amount, type, color and odor) of the active ear together with the results of type of bacteria and culture and sensitivity tests are collected in a questionnaire.

### B- Bacterial isolation:

Aural discharge was taken from the draining ears of the patients with chronic suppurative otitis media attending the outpatient clinic. Aural discharge was collected from the discharging ear by using sterilized ear swab. Collected swabs are then send to the microbiology laboratory for microbiological analysis.

For bacterial isolation, the specimen was inoculated on blood agar, MacConkey's agar and chocolate agar. The culture plates were incubated aerobically at 37 °C for 24 to 48 hours. Loopfull from growing colonies were inoculated into Molar Agar for subsequent biochemical tests. Gram positive isolates were tests for catalase and coagulase tests. Gram negative isolates were tests for oxidase enzymes, urease production and citrate utilization. Some of these chemical tests done manually and some done by Autoanalyzer (Vitek 2) compact device.

### Statistical analysis

The statistical significance level was established at a P-value  $\leq 0.05$ .

### Results

**Table (1):** The relationship between age, gender and side of the involved ear with infection. Data presented as frequency and percentage, Chi-square calculations (X2-test) are used to compare all values (Number of patients = 46)

Age	Frequency and percentage	Male	Female	Unilateral		Bilateral
				Right ear	Left ear	
10-19 years	(10)21.7%	(6)60%	(4)40%	(4)40%	(4)40%	(2)20%
20-29 years	(5)10.8%	(5)100%	0	(3)60%	(2)40%	0
30-39 years	(10)21.7%	(3)30%	(7)70%	(6)60%	(4)40%	0
40-49 years	(14)30.4%	(6)42%	(8)57.1	(7)50%	(6)42.8%	(1)7.2%
$\geq 50$ years	(7)15.2%	(3)42.8%	(4)57.1%	(2)28.5%	(3)42.8%	(2)14.2%
Total	(46) 100%	(23)50%	(23)50%	(22) 47.8%	(19)41.3	(5)10.8%
<i>P-value</i>		$\leq 0.1$		$\leq 0.05$		$\leq 0.001$

40-49 years old group was the highest frequency of patients with chronic suppurative otitis media 14 (30.4%).20-29 years group was the lowest

involved group 5 (10.8%).Right ear involvement (47.85%) is more than the left ear involvement in 19 patients (41.3%).

**Table (2):** The relation of type of bacteria to chronic suppurative otitis media discharge. Data presented as frequency and percentage. One-way ANOVA with Kruskal-Wallis test and Dunnett's multi-comparison test were used to compare between all collected data

Type of bacteria	Amount		Color			Odor		Type	
	Profuse	Scanty	Yellowish	Yellow-Greenish	Greenish	Bad	Not Bad	Mucopurulent	Purulent
<i>Achromobacter xylosoxidans</i>	(1)3.5%	0	(1)3.2%	0	0	(1)3.3%	0	(1)4%	0
<i>Acinetobacter baumannii</i>	(3)10.7%	0	(3)9.6%	0	0	0	(3)9.8%	(2)8%	(1)3.8%
<i>Bordetella hinzii</i>	(1)3.5%	0	(1)3.2%	0	0	0	(1)4.8%	(1)4%	0
<i>Escherichia coli</i>	0	(1)4.3 %	(1)3.2%	0	0	(1)3.3%	0	0	(1)3.8%
<i>Enterobacter cloacae</i>	(3)10.7%	0	(3)9.6%	0	0	(2)6.7%	(1)4.8%	(3)12%	0
<i>Klebsiella pneumoniae</i>	(2)7.1%	(4)17.4%	(4)12.9%	(2)15.5%	0	(5)16.7 %	(1)4.8%	(1)4%	(5)19.3%
<i>Pseudomonas putida</i>	0	(1)4.3 %	(1)3.2%	0	0	(1)3.3%	0	0	(1)3.8%
<i>Pseudomonas aeruginosa</i>	(4)14.2%	(17) 74 %	(4)12.9%	(10)76.9%	(7)100%	(15)50%	(6)28.6 %	(4)16%	(17)65.5%
<i>Proteus mirabilis</i>	(4)14.2%	0	(3)9.6%	(1)7.6%	0	(2)6.7%	(2)9.5%	(4)16%	0
<i>Staphylococcus aureus</i>	(6)21.4%	0	(6)19.8%	0	0	(2)6.7%	(4)19.4%	(5)20%	(1)3.8%
<i>Staphylococcus haemolyticus</i>	(2)7.1%	0	(2)6.4%	0	0	0	(2)9.5%	(2)8%	0
<i>Staphylococcus lugdunensis</i>	(1)3.5%	0	(1)3.2 %	0	0	(1)3.3%	0	(1)4%	0
<i>Serratia rubidaea</i>	(1)3.5%	0	(1)3.2 %	0	0	0	(1)4.8%	(1)4%	0
Total	28(55%)	23(45%)	31(60.8%)	13(25.5%)	7(13.7%)	30(59%)	21(41%)	25(49%)	26(51%)
Statistics	P value ≤ 0.01								

**Table (3):** Types of bacteria that found in chronic suppurative otitis media. Data presented as frequency and percentage, Student's t-test and the Mann–Whitney U test were used to compare the data

Type of bacteria	Mucosal COM	Squamous COM	Frequency and percentage of clinical isolates
<i>Achromobacter xylosoxidans</i>	(1)3.7%	0	(1) 2%
<i>Acintobacter baumannii</i>	(3)11.1%	0	(3) 5.9%
<i>Bordetella hinzii</i>	(1)3.7%	0	(1) 2%
<i>Escherichia coli</i>	0	(1)4.1%	(1) 2%
<i>Enterobacter cloacae</i>	(3)11.1%	0	(3) 5.9%
<i>Klebsiella pneumoniae</i>	(1)3.7%	(5)20.8%	(6) 11.6%
<i>Pseudomonas putida</i>	0	(1)4.1%	(1) 2%
<i>Pseudomonas aeruginosa</i>	(4) 14.8%	(17)71%	(21)41.2%
<i>Proteus mirabilis</i>	(4)14.8%	0	(4)7.8%
<i>Staphylococcus aureus</i>	(6)22.2%	0	(6)11.6%
<i>Staphylococcus haemolyticus</i>	(2)7.4%	0	(2) 4%
<i>Staphylococcus lugdunensis</i>	(1)3.7%	0	(1) 2%
<i>Serratia rubidaea</i>	(1)3.7%	0	(1) 2%
Total	(27)53%	(24)47%	51(100%)
Statistics	P-value $\leq$ 0.1		

The Bacterial infection was caused mostly by *Pseudomonas aeruginosa* isolates (41.2%).

The highest Mucosal COM was accompanied with *Staphylococcus aureus*

infection (22.2%).The highest Squamous COM was accompanied with *Pseudomonas aeruginosa* infection (71%).

**Table (4):** Multidrug sensitive/resistance pattern (%) of bacterial pathogens isolated from Chronic suppurative otitis media patients (Number of patients = 46) at Al-Yarmouk teaching hospital. One-way ANOVA with Kruskal-Wallis test and Dunnett's multi-comparison test were used

Type of bacteria	Antimicrobial agent																Statistics
	Amikacin	Amoxicillin	Ampicillin	Cefixime	Ceftazidime	Ceftriaxone	Chloramphenicol	Ciprofloxacin	Genitamicin	Imipenem	Levofloxacin	Meropenem	Piperacillin	Tetracycline	Tobramycin	Trimethoprim	
Achromobacter xylosoxidans	R	S	S	R	R	S	R	R	R	S	S	S	R	S	R	S	
Acinetobacter baumannii	S	S	S	S	S	R	R	R	S	S	S	S	R	S	S	S	
Bordetella hinzii	S	S	S	R	S	R	R	S	S	S	S	S	R	S	S	S	
E.coli	S	S	S	R	S	R	S	S	R	S	R	S	S	R	S	S	
Enterobacter cloacae	S	S	S	R	R	R	S	S	R	S	R	S	R	R	S	R	
Klebsiella pneumoniae	S	S	R	R	R	S	S	S	S	S	S	S	R	S	S	R	
P.Aeruginosa	S	R	R	R	R	R	R	S	R	S	R	S	S	R	R	R	
P.putida	S	R	R	R	R	S	R	S	S	S	S	S	R	R	S	R	
Proteus mirabilis	S	S	R	S	R	S	S	S	S	S	S	S	S	R	S	S	
Staph.aureus	S	S	S	S	R	S	S	S	S	S	S	S	S	S	R	R	
Staph. haemolyticus	S	S	S	S	S	R	S	R	R	S	S	S	S	R	R	R	
Staph. lugdunensis	S	S	R	S	S	S	S	S	R	S	S	S	S	R	S	S	
Serratia rubidaea	S	S	S	R	S	R	S	S	S	S	S	S	S	S	S	S	
Sensitive (%)	92	85	62	38	46	46	62	77	54	100	77	100	54	46	69	54	P-value 0.001
Resistance (%)	8	15	38	62	54	54	38	23	46	0	23	0	46	54	31	46	

\* The antimicrobial susceptibility pattern of isolated bacteria based the criteria of Laboratory Standards Institute [CLSI, 2014]. R resistance; S sensitive

The bacterial isolates were completely sensitive (S) toward Meropenem & Imipenem (100%). The highest level of bacterial resistance (R) was against Cefixime (62%).

**Table (5):** Antibiotic sensitivity/resistance pattern of bacteria toward 16 antibiotics. Data presented as type and percentage (%). Chi-square calculations (X2-test) are used to compare all values

Antimicrobial agent	Sensitive (%)	Resistance (%)
Amikacin	92	8
Amoxicillin	85	15
Ampicillin	62	38
Cefixime	38	62
Ceftazidime	46	54
Ceftriaxone	46	54
Chloramphenicol	62	38
Ciprofloxacin	77	23
Gentamicin	54	46
Imipenem	100	0
Levofloxacin	77	23
Meropenem	100	0
Piperacillin	54	46
Tetracycline	46	54
Tobramycin	69	31
Trimethoprim	46	54
Statistic	<b><i>P-value = 0.01</i></b>	

\*The antimicrobial susceptibility pattern of isolated bacteria based the criteria of Laboratory Standards Institute [CLSI, 2014]. R resistance; S sensitive

The bacterial isolates were completely sensitive (S) toward Meropenem & Imipenem (100%). The highest level of bacterial resistance (R) was against Cefixime (62%).

## Discussion

The findings compared with other studies as follow:

1- Number and gender distribution: In relation to gender, we found that 23 of them were male (50%) and 23 of them were females (50%) and this is because no known anatomical or genetic differences between male and females pertaining the ear exists. In a study of patients by Shyamala, et al. [7].

2- Age distribution: In relation to the age group, this study includes wide range of

peoples from (10 to over 50 years old). The majority of cases 14 (30.4%) were within the age group (40-49 years) and the minority (10.8%) were (20-29 years) of age. In another study by Shrestha, et al. [8] with a total of 230 patients, they found that the most involved age group (21-30 years) 43 (18.7%). In a similar study by Loy AH, et al. [9] the commonest group that were involved (31-40 years).

3- Side of ear involvement: In relation to the side of the ear involvement we found that 22 of the patients were have right ear involvement (47.85%) while the left ear involved in 19 patients (41.3%).

Majority of the cases were unilaterally discharging 41 (89.2%) while bilaterally of 5

patients (10.8%). In 2 out of 5 patients with bilateral ear involvement there were a difference in the type of bacteria isolated from the 2 ears as they have a right ear pathogen different from the left ear pathogen and this result was reported with a previous similar studies. In a study done by M Chirwa, et al. [10] the total patients were 104, 90 patients (86.5%) with unilateral disease and 14 patients (6.7%) with bilateral disease.

In a study by Shrestha, et al. [8] of 230 patients the right ear was involved in 114 cases (49.6%) and the left ear in 102 cases (44.3%) and bilateral (6.1%). In a study by Abraham ZS, et al. [11] unilateral involvement (97.5%) was commoner than bilaterally (2.5%). Left ear infections and bilaterally accounted for 58.3% and 2.5% of the cases respectively.

4- Clinical picture distribution: Regarding amount of aural discharge, the discharge was mostly profuse in 28 ears (55%) and the least is scanty in 23 ears (45%). Discharge was foul smell in 30 ears (59%) and odorless in 21 ears (41%).

Discharge was mostly purulent in 26 ears (51%) and the least is mucopurulent in 25 ears (49%). Profuse discharge was mostly caused by Staphylococcus aureus in 6 ears (21.4%). Scanty discharge was commoner type of discharge by Pseudomonas aeruginosa in 17 ears (74%). Pseudomonas aeruginosa discharge was the foulest discharge in 15 ears (50%). In a study done by M Chirwa, et al. [10] the total number of patients were 104, discharge was profuse in 55 ears (46.6%) and scanty in 63 ears

(53.4%), discharge was foul smell in 90 ears (76.25%) and odorless in 28 (23.8%).

In a study by Chowdhury MA, et al. [13] aural discharge was mucopurulent in majority of cases 80% and foul-smelling scanty ear discharge was from 88% of subjects.

5- Type of Chronic otitis media distribution: Majority of cases were mucosal type 27 ears (53%) while squamous Otitis media were present within 24 ears (47%). Squamous chronic otitis media were mostly caused by Pseudomonas aeruginosa in 17 ears (71%) while Staphylococcus aureus was the most common cause of mucosal chronic otitis media in 6 ears (22.2%). In a study by Shrestha, B., et al. [14]. The results showed that, out of 200 cases, 120 (60%) were chronic otitis media- mucosal and 80 (40%) were chronic otitis media – squamous.

6- Types of bacteria found in chronic otitis media: The total number of pathogens isolated from 46 patients (51 ears) were 13 types of bacteria. We found that Gram negative bacteria accounted for the majority of organisms in 42 ears (82.4%) while Gram positive bacteria accounted for the least 9 ears (17.6%). The most common pathogen was Pseudomonas aeruginosa in 21 ears (41.2%) followed by Staphylococcus aureus in 6 ears (11.6%). In a study by Kumar H, et al. [15], Analysis of isolated bacteria showed predominance of gram negative bacteria (59.74%).

In a study of patients by Shyamala, et al. [7] the majority of cases were caused by Pseudomonas aeruginosa 40% followed by



Staphylococcus aureus and the Escherichia coli respectively.

In a similar study done by Mansoor T, et al. [16] with a total of 263 patients the Pseudomonas aeruginosa (40%) and Staphylococcus aureus (30.9%) were the most common pathogens found In Chronic suppurative otitis media.

7- Sensitivity of bacteria to antibiotics: We have used 16 Antibiotics in this study. The highest effective antibiotics against these 13 pathogens were Imipenem and Meropenem equally (100%) followed by Amikacin (92%). The lowest effective antibiotic was Cefixime of (62%) resistance. In a study by Jang CH, et al. [17].Pseudomonas aeruginosa were tested against 16 antibiotics. Imipenem was the most sensitive antibiotic agent of 96.5% followed by amikacin (55.6%). This study goes with our study.

In another study by Pallawi Goyal, et al. [18] they found Gram negative bacilli were most sensitive to Meropenem (95.45%), Amikacin (91%) and Netilmicin (91%) while Pseudomonas aeruginosa was sensitive to Imipenem (98.3%).

## Conclusions

There was a relation between particular suppurative chronic otitis media causing microorganisms and specific discharge. The most common pathogen was Pseudomonas aeruginosa followed by Staphylococcus aureus. Imipenem, Meropenem and Amikacin are highly recommended as the first line treatments in patients with chronic suppurative otitis media while the lowest effective antibiotic was Cefixime. Anaerobic

media and specific tests for anaerobic bacteria isolation

## References

- [1] Gleeson, M. and Scott-Brown, W. Scott-Brown's otorhinolaryngology, head and neck surgery, 2008, Volume 3. 7th ed. London: Hodder Arnold, pp.3396-439.
- [2] Goycoolea MV, Hueb MM, Ruah C. Definitions and terminology. Otolaryngol Clin North America, 1991, 24 (4): 757-761.
- [3] Smith AW, Hatcher J, Mackenzie, IJ, Thompson S, Bal J, Mac P, Okoth-Olende C, Oburra H, Wanjohi Z. Randomised control of chronic suppurative otitis media in Kenyan schoolchildren. Lancet, 1996, 348: 1128-1133.
- [4] WHO. Child and adolescent health and development. Prevention of blindness and deafness. Chronic suppurative otitis media. Burden of illness and management options. Geneva: WHO; 2004.
- [5] Prezwonzy T, Kuczkowski J. Hearing loss in patients with external complications of chronic otitis media. Otolaryngologia Polska. 2017; 71(3):36-42.
- [6] Minami S, Mutai H, Suzuki T et al. Microbiomes of the normal middle ear and ears with chronic otitis media. The Laryngoscope. 2017; 127(10): E371-E377.
- [7] Shyamala, R & Reddy, P. The study of bacteriological agents of chronic suppurative otitis media -Aerobic culture and evaluation. J Microbiol Biotechnol Res. 2011,2.
- [8] Shrestha, B., Amatya, R., Shrestha, I., & Ghosh, I. Microbiological Profile of Chronic Suppurative Otitis Media. Nepalese Journal

- of ENT Head and Neck Surgery, 2012, 2(2), 6-7.
- [9]Loy AH, Tan AL, Lu PK. Microbiology of chronic suppurative otitis media in Singapore. Singapore Med J. 2002 Jun; 43(6):296-9.
- [10]M Chirwa, W Mulwafu and D Soko. Microbiology of chronic suppurative otitis media at Queen Elizabeth Central Hospital. Malawi Med J. 2015 Dec; 27(4): 120–12.
- [11]Abraham ZS, Ntunaguzi D, Kahinga AA, Mapondella KB, Massawe ER, Nkuwi EJ, Nkya A. Prevalence and etiological agents for chronic suppurative otitis media in a tertiary hospital in Tanzania. BMC Res Notes. 2019 Jul 17;12(1):429. doi: 10.1186/s13104-019-4483-x.
- [12]Tiedt NJ, Butler IR, Atkins MD. Paediatric chronic suppurative otitis media in the Free State Province: Clinical and audiological features. South African medical journal. 2013;103(7):467-70.
- [13]Chowdhury MA, Alauddin M, Comparative study between tubotympanic and atticofurcal types of chronic suppurative otitis media. Bangladesh Med Res Counc Bull. 2002 Apr; 28(1):36-4.
- [14]Shrestha, B., Shrestha, I., & Amatya, R. Comparison of clinical presentation between Chronic Otitis Media Mucosal with Squamous. Kathmandu University Medical Journal, (2012), 8(4), 387-391.
- [15] Kumar H, Seth S. Bacterial and Fungal study of 100 cases of Chronic otitis media. J Clin Diag Res. 2011; 5:1224–1227.
- [16]Mansoor T, Musani MA, Khalid G, Kamal M. Pseudomonas aeruginosa in chronic suppurative otitis media: sensitivity spectrum against various antibiotics in Karachi. J Ayub Med Coll Abbottabad. 2009 Apr-Jun;21(2):120-3.
- [17]Jang CH, Park SY. Emergence of ciprofloxacin-resistant pseudomonas in chronic suppurative otitis media. Clin Otolaryngol Allied Sci. 2004 Aug;29(4):321-3 .
- [18]Pallawi Goyal, Ramesh Kumar Mishra, Anita Singhal, Rakesh Kumar Maheshwari. Microbial profile with their antimicrobial susceptibility pattern in ear discharge of CSOM patients at a tertiary care hospital in Northern Rajasthan. International Journal of Medical and Health Research. Volume 4; Issue 8; August 2018; page No. 152-156.