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Original Article

# Evaluation of Causative Microorganisms and their Antibiotic Sensitivity Patterns in Chronic Suppurative Otitis Media at Combined Military Hospital, Hyderabad, Sindh

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## ABSTRACT

***Objectives***: To determine frequency of causative microorganisms and their antibiotic sensitivity patterns in chronic suppurative otitis media (CSOM).

***Study Design***: Cross sectional study.

***Place and Duration of Study***: ENT Department, Combined Military Hospital, Hyderabad Pakistan, from May 2023 to May 2024.

***Methodology***: A total of 101 male and female patients aged above 15 years who were diagnosed as cases of chronic suppurative otitis media with otorrhea through tympanic membrane perforation were included in the study. Patients were assessed for the causative organism along with its antibiotic sensitivity pattern using standardized techniques.

***Results***: Median age was 30.00 (50.00 – 16.00) years. There were 64(63.37%) male and 37(36.63%) females. Most common causative organism was Pseudomonas aeruginosa found in 51(50.50%) followed by Proteus 27(26.73%). Highest sensitivity was detected for Meropenem 79(78.22%) followed by Cefepime 70(69.31%), Cefoperazone – Sulbactam 68(67.33%), Imipenem 58(57.43%), Piperacillin – Tazobactam 58(57.43%) and Rifampicin 52(51.49%).

***Conclusion***: Most common organisms causing Chronic Suppurative Otitis Media are Pseudomonas aeruginosa and Proteus. Highest sensitivity was observed for meropenem and cefepime while highest resistance was observed against methicillin, co-amoxiclav and tobramycin.

**Keywords**: Antibiotic, Antimicrobial Agents, Chronic Suppurative Otitis Media, Organism.

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## INTRODUCTION

Chronic suppurative otitis media (CSOM) is the common ear infection globally with an approximate incidence of 31 million people annually and prevalence of 3.8%.[1,2] This infection has the potential to cause perforation of the tympanic membrane (TM) for which surgical tympanoplasty is often performed to manage hearing loss.[3,4] Perforation of the TM in cases of CSOM occurs due to persistent production of inflammatory and infectious ear discharge which weakens the TM and eventually causes its perforation.[5] Pattern of TM perforation can be variable which can lead to varying degrees and type of hearing loss.[6] This variability is not just driven by the pattern of TM perforation, but also by the patient demographics and it has been observed that there is a high degree of variability in prevalence and severity patterns of hearing loss among developing and industrialized nations.[7]

Since, CSOM can cause permanent hearing loss, it is essential to effectively eradicate the pathogen causing this infection by using appropriate antimicrobial agents.[8] However, global patterns of antibiotic susceptibility and resistance have demonstrated that antimicrobial resistance has been persistently increasing leading to high rates of treatment failure.[9] In this instance, a study was conducted to assess the frequency of antibiotics resistance in CSOM causing organisms which revealed that the frequency of antibiotics resistance can be as high as 80% in CSOM patients.[10]

Susceptibility patterns of antibiotics differ greatly in different demographics. Therefore, it is essential to explore the spectrum of organism along with their antibiotic susceptibility patterns causing CSOM in local population. To achieve this, present study was conducted to determine spectrum of causative microorganisms and their antibiotic sensitivity patterns causing CSOM.

## METHODOLOGY

This cross-sectional study was conducted at Combined Military Hospital, ENT Department, Hyderabad, Pakistan from May 2023 to May 2024 after

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approval from the Institutional Ethical Review Committee (IERB #: 111).

**Inclusion Criteria**: Patients of either gender, aged above 15 years who were diagnosed as cases of CSOM with otorrhea through tympanic membrane (TM) perforation for more than six weeks were included.

**Exclusion Criteria**: Patients exhibiting bilateral ear involvement, culture negative samples, intact TM, congenital hearing impairment, previous history of middle ear surgery, those on ototoxic medications, individuals with structural ear diseases, mentally incapacitated persons unable to adhere to instructions, individuals with traumatic ear injuries, patients currently on antibiotics, those who have taken antibiotics within the last ten days, pregnant women and individuals with comorbidities were excluded.

For calculation of sample size we used WHO calculator, taking anticipated frequency of Proteus being causative organism in CSOM patients of 21.3%.[11] This gave a sample size of 101.

Data was collected using a non-probability consecutive sampling technique. All study participants signed a written consent form prior to their enrollment in the study. Baseline characteristics included age, gender and laterality of disease were documented. After this, a detailed examination of the ear was performed by a consultant ENT surgeon, with a minimum experience of five years, during which under aseptic environment collection of samples was performed.

The sample of ear discharge was collected by using mini-tip swab which was sent to in-hospital pathology laboratory for culture and sensitivity testing to assess spectrum of causative organisms and their respective susceptibility to antibiotics. For culture and identification of causative organism, collected sample was inoculated on chocolate, McConkey, and blood agar. Both aerobic and anaerobic cultures were performed. These culture media were then analyzed through microscopy and various organism specific tests (like oxidase and motility test) to determine the causative organism of CSOM.

All the isolates were also assessed for susceptibility for antimicrobial agents frequently used at the institutional level through disc diffusion method. In this method, the culture media was impregnated with a variety of antibiotic discs to see the patterns of growth around these plates. In addition, if any antibiotic exhibited intermediate level of sensitivity, it was still labelled as resistant. Once the reports were available, targeted antibiotic therapy was given to all CSOM patients to ensure effective treatment and favorable patient outcomes. Process of patient selection and evaluation is given in following flow diagram (Figure).

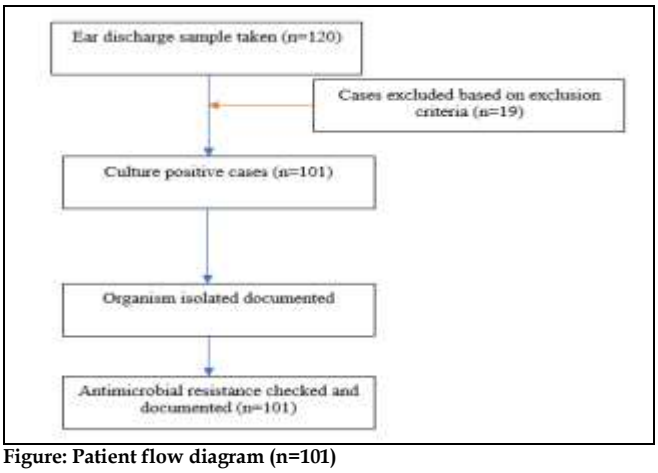


**Figure: Patient flow diagram (n=101)**

Analysis of collected data was performed using Statistical Package for Social Sciences (SPSS) version 22. Normality of data was assessed using Shapiro-Wilk test which showed age was not distributed normally and was thus represented as median with interquartile range (IQR). Categorical variables were represented using percentage and frequency.

## RESULTS

In this study, 101 patients with CSOM were assessed. Median age was 30.00 (50.00 – 16.00) years. There were 64(63.37%) male and 37(36.63%) females. In 52(51.49%) patients, right ear was involved while in 49(48.51%) patients left ear was involved. Patient demographics are given below in Table-I.

**Table-I: Demographic Characteristics of Patients (n = 101)**

| Demographic | Values |
|---|---|
| Age in years<br>Median (IQR) | 30.00 (50.00 – 16.00) years |
| **Gender** | |
| Male | 64(63.37%) |
| Female | 37(36.63%) |
| **Laterality** | |
| Right ear | 52(51.49%) |
| Left ear | 49(48.51%) |

Most common organism isolated on culture was Pseudomonas aeruginosa found in 51(50.50%) samples, followed by Proteus sp, which was seen in 27(26.73%) samples, methicillin resistant Staphylococcus aureus in 11(10.89%), methicillin sensitive Staphylococcus aureus in 9(8.91%) and Klebsiella sp. in 3(2.97%) samples. This is demonstrated below in Table-II.

**Table-II: Pattern of Causative Organisms (n=101)**

| Organism | n(%) |
|---|---|
| Pseudomonas aeruginosa | 51(50.50%) |
| Proteus sp. | 27(26.73%) |
| Methicillin Resistant Staphylococcus aureus (MRSA) | 11(10.89%) |
| Methicillin Sensitive Staphylococcus aureus (MSSA) | 9(8.91%) |
| Klebsiella sp. | 3(2.97%) |

General pattern of antibiotic susceptibility pattern is given below in Table-III.

**Table-III: Antibiotic susceptibility pattern (n=101)**

| Antibiotic | Sensitive (S) n(%) | Resistant (R) n(%) |
|---|---|---|
| Amikacin | 40(39.60%) | 61(60.40%) |
| Co-amoxiclav | 18(17.82%) | 83(82.18%) |
| Methicillin | 12(11.88%) | 89(88.12%) |
| Cefepime | 70(69.31%) | 31(30.69%) |
| Ceftriaxone | 43(42.57%) | 58(57.43%) |
| Ciprofloxacin | 40(39.60%) | 61(60.40%) |
| Cefoperazone – Sulbactam | 68(67.33%) | 33(32.67%) |
| Erythromycin | 32(31.68%) | 69(68.32%) |
| Fusidic Acid | 42(41.58%) | 59(58.42%) |
| Gentamicin | 35(34.65%) | 66(65.35%) |
| Imipenem | 58(57.43%) | 43(42.57%) |
| Meropenem | 79(78.22%) | 22(21.78%) |
| Piperacillin - Tazobactam | 58(57.43%) | 43(42.57%) |
| Rifampicin | 52(51.49%) | 49(48.51%) |
| Trimpethoprim – Sulfamethoxazole (TMP-SMZ) | 40(39.60%) | 61(60.40%) |
| Tobramycin | 18(17.82%) | 83(82.18%) |
| Doxycycline | 32(31.68%) | 69(68.32%) |

**TMP-SMZ: Sulfamethoxazole-Trimethoprim*

Antibiotic sensitivity pattern in different causative organisms is given below in Table-IV.

**Table-IV: Antibiotic Sensitivity pattern in different Causative Organisms (n=101)**

| Antibiotic | Organisms | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pseudomonas (n=51) n(%) | | Proteus sp. (n=27) n(%) | | MRSA (n=11) n(%) | | MSSA (n=9) n(%) | | Klebsiella (n=3) n(%) | |
| | S | R | S | R | S | R | S | R | S | R |
| Amikacin | 20 (39.22%) | 31 (60.78%) | 11 (40.74%) | 16 (59.26%) | 4 (36.36%) | 7 (63.64%) | 3 (33.33%) | 6 (66.67%) | 2 (66.67%) | 1 (33.33%) |
| Co-amoxiclav | 10 (19.61%) | 41 (80.39%) | 5 (18.52%) | 22 (81.48%) | 2 (18.18%) | 9 (81.82%) | 1 (11.11%) | 8 (88.89%) | 0 (0.00%) | 3 (100%) |
| Methicillin | 7 (13.73%) | 44 (86.27%) | 2 (7.41%) | 25 (92.59%) | 1 (9.09%) | 10 (90.91%) | 2 (22.22%) | 7 (77.78%) | 0 (0.00%) | 3 (100%) |
| Cefepime | 35 (68.63%) | 16 (31.37%) | 19 (70.37%) | 8 (29.63%) | 5 (45.45%) | 6 (54.55%) | 8 (88.89%) | 1 (11.11%) | 3 (100%) | 0 (0.00%) |
| Ceftriaxone | 20 (39.22%) | 31 (60.78%) | 14 (51.85%) | 13 (48.15%) | 4 (36.36%) | 7 (63.64%) | 4 (44.44%) | 5 (55.56%) | 1 (33.33%) | 2 (66.67%) |
| Ciprofloxacin | 18 (35.29%) | 33 (64.71%) | 20 (74.07%) | 7 (25.93%) | 2 (18.18%) | 9 (81.82%) | 5 (55.56%) | 4 (44.44%) | 1 (33.33%) | 2 (66.67%) |
| Cefoperazone – Sulbactam | 33 (64.71%) | 18 (35.29%) | 20 (74.07%) | 7 (25.93%) | 8 (72.73%) | 3 (27.27%) | 5 (55.56%) | 4 (44.44%) | 2 (66.67%) | 1 (33.33%) |
| Erythromycin | 16 (31.37%) | 35 (68.63%) | 8 (29.63%) | 19 (70.37%) | 5 (45.45%) | 6 (54.55%) | 3 (33.33%) | 6 (66.67%) | 0 (0.00%) | 3 (100%) |
| Fusidic Acid | 22 (43.14%) | 29 (56.86%) | 9 (33.33%) | 18 (66.67%) | 8 (72.73%) | 3 (27.27%) | 3 (33.33%) | 6 (66.67%) | 0 (0.00%) | 3 (100%) |
| Gentamicin | 17 (33.33%) | 34 (66.67%) | 9 (33.33%) | 18 (66.67%) | 4 (36.36%) | 7 (63.64%) | 4 (44.44%) | 5 (55.56%) | 2 (66.67%) | 1 (33.33%) |
| Imipenem | 20 (39.22%) | 31 (60.78%) | 12 (44.44%) | 15 (55.56%) | 8 (72.73%) | 3 (27.27%) | 5 (55.56%) | 4 (44.44%) | 2 (66.67%) | 1 (33.33%) |
| Meropenem | 40 (78.43%) | 11 (21.57%) | 21 (77.78%) | 6 (22.22%) | 9 (81.82%) | 2 (18.18%) | 6 (66.67%) | 3 (33.33%) | 3 (100%) | 0 (0.00%) |
| Piperacillin – Tazobactam | 31 (60.78%) | 20 (39.22%) | 12 (44.44%) | 15 (55.56%) | 8 (72.73%) | 3 (27.27%) | 5 (55.56%) | 4 (44.44%) | 2 (66.67%) | 1 (33.33%) |
| Rifampicin | 25 (49.02%) | 26 (50.98%) | 14 (51.85%) | 13 (48.15%) | 7 (63.64%) | 4 (36.36%) | 4 (44.44%) | 5 (55.56%) | 2 (66.67%) | 1 (33.33%) |
| TMP – SMZ | 20 (39.22%) | 31 (60.78%) | 11 (40.74%) | 16 (59.26%) | 6 (54.55%) | 5 (45.45%) | 2 (22.22%) | 7 (77.78%) | 1 (33.33%) | 2 (66.67%) |
| Tobramycin | 9 (17.65%) | 42 (82.35%) | 5 (18.52%) | 22 (81.48%) | 2 (18.18%) | 9 (81.82%) | 1 (11.11%) | 8 (88.89%) | 1 (33.33%) | 2 (66.67%) |
| Doxycycline | 17 (33.33%) | 34 (66.67%) | 8 (29.63%) | 19 (70.37%) | 6 (54.55%) | 5 (45.45%) | 1 (11.11%) | 8 (88.89%) | 0 (0.00%) | 3 (100%) |

**S: Sensitive, R: Resistant, MRSA: Methicillin Resistant Staphylococcus aureus, MSSA: Methicillin Sensitive Staphylococcus aureus, TMP-SMZ: Sulfamethoxazole-Trimethoprim*

## DISCUSSION

CSOM is an infectious and inflammatory disorder of the middle ear, characterized by continuous otorrhea through a perforated TM.[12,13] It is one of the most prevalent reversible causes of deafness worldwide; yet, it can lead to permanent hearing loss if not treated appropriately and timely.[14] Present study focused on the frequency of causative microorganisms and their antibiotic sensitivity patterns in the local population of Hyderabad since likelihood of CSOM is quite high in this population due to hot and humid climate.

The average age of patients with CSOM and TM perforation in the current study was 30 years. Compared to this, a study reported clinical characteristics of patients suffering from CSOM and they found that the mean age of patients with CSOM was also approximately 38 years, which was relatively higher compared to present study.[15] These findings exhibit that this condition is more common in younger population which could be due to higher exposure of this age group to environmental pathogens owing to their indulgence in outdoor activities.

Our study revealed that majority of CSOM patients were male making up approximately 64% of the study population, thereby exhibiting a male predominance. This male predominance has also been reported in a previous study in which it was found that among all the CSOM sufferers, 58% were males.[16] On the contrary, in another study, when the clinical characteristics of CSOM patients were analyzed, there was a female predominance with females making up 74.8% of the CSOM sufferers.[17] The reason behind this contrasting demographic statistics could not be determined, but could be due to the difference in gender distribution in the localities where studies were conducted.

In terms of spectrum of causative organisms, the most common microbe identified that resulted in development of CSOM was Pseudomonas. Similar to this trend, a study was conducted among CSOM patients of Somalia in which it was reported that the major culprit of causing this morbidity of the middle ear was Pseudomonas.[18] Similarly, among Malaysian population suffering from this chronic infection, Pseudomonas was the major microbe involved in its etiology.[19] Second most common organism that resulted in development of CSOM in present study was Proteus. In studies conducted in India, it was observed that most common pathogen causing CSOM

was Pseudomonas, similar to current study, however, the second most common organism was Staphylococcus aureus instead of Proteus.[20,21]

One of the most worrying findings of current study was high degree of resistance against a wide range of antimicrobial agents (particularly ciprofloxacin) that are usually used for management of the patients suffering from CSOM. In this instance, it was observed that not only the classical antibiotics (like methicillin, co-amoxiclav and tobramycin), but even the newer drugs showed a significant degree of resistance. Previous studies conducted in India and Pakistan have also demonstrated this high level of antimicrobial resistance in CSOM patients.[21,22] This is an alarming situation and can be attributed to various reasons, particularly in this region of the world. One of the reasons could be unnecessary use of antibiotics by the general public on their own, without a doctor's prescription. Another possible reason behind this could be injudicious prescription of antibiotics by general physicians, including both classical as well as modern formulations. This study provides important insights regarding the spectrum of microbes as well as their antibiotic susceptibility pattern which cause CSOM.

## LIMITATION OF STUDY

Our main limitations were a small sample size, and the fact that this was a single-center study, that too, a center that mainly serves a particular faction of the population. These issues may limit the generalizability of our findings.

## CONCLUSION

Most common organism causing CSOM is Pseudomonas aeruginosa and Proteus. Highest sensitivity was observed for meropenem and cefepime, while highest resistance was observed against methicillin, co-amoxiclav and tobramycin.

**Conflict of Interest:** None.

**Funding Source:** None.

**Authors' Contribution**

Following authors have made substantial contributions to the manuscript as under:

MI & FA: Data acquisition, data analysis, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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