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Bacteriological Profile and Drug Susceptibility in Mucosal type Chronic Suppurative Otitis Media

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ABSTRACT

Background: In Chronic Suppurative Otitis Media, mucosal type, most common organisms are *Pseudomonas aeruginosa* and *Proteus species* (*P. mirabilis* and *P. vulgaris*). It is important to prescribe culture-directed antibiotics to prevent resistance. This study was conducted to determine the bacteriological profile and drug susceptibility in patient with chronic suppurative otitis media.

Methods: This is a hospital-based descriptive study done at Gandaki Medical College, Pokhara, Nepal from July 2019 to June 2020. Under aseptic condition, the swab specimens were obtained from patients with history of ear discharge of >12 weeks duration and findings central perforation of the tympanic membrane. The sample was labeled and immediately transferred to the microbiology lab for culture/sensitivity test according to the guidelines of the Clinical and Laboratory Standards Institute.

Results: Out of total 127 patients, 48 (37.8%) were male and 79 (62.2%) were female. One hundred and seven samples (84.3%) had positive culture while 20 samples (15.7%) had no growth. *Staphylococcus aureus* (43%), was the most common isolate followed by *Pseudomonas aeruginosa* (23.4%), *Proteus mirabilis* (9.3%), and *Escherichia coli* (8.4%). All the organisms isolated were 100% sensitive to imipenem followed by 96.2% sensitive to gentamicin and 95.3% to amikacin.

Conclusions: *Staphylococcus aureus* (43%) was the most predominant isolate followed by *Pseudomonas aeruginosa* (23.4%), *Proteus mirabilis* (9.3%), and *Escherichia coli* (8.4%). Imipenem was the most sensitive antibiotic (100%) followed by gentamicin (96.2%), amikacin (95.3%), and ofloxacin (88.78%).

Keywords: Antibiotic susceptibility; bacteriology; chronic suppurative otitis media

INTRODUCTION

Chronic Suppurative Otitis Media(CSOM) is more common in developing nation with undernutrition, overcrowding, poor hygiene, frequent upper respiratory tract infections, and under-resourced health care.[1] The most common organisms isolated in mucosal type of CSOM are *Pseudomonas aeruginosa* and *Proteus species* (*P. mirabilis* and *P. vulgaris*), which are gram-negative bacteria. *Staphylococcus aureus* is the most common gram-positive organism followed by *Escherichia coli*, *Streptococcus pneumoniae* while *Bacteroides species* account for the anaerobic organism. *Pseudomonas* is well known to produce proteases and lipopolysaccharides which hinder normal immunologic defense mechanisms.[2]

The increasing drug resistance due to beta-lactamase-producing microorganisms and formation of biofilm resulting in treatment failure.[3] It is important to prescribe culture-directed antibiotics for effective outcomes. The present study aimed to identify the bacterial pathogen in the case of chronic suppurative otitis media and their sensitivity to antibiotics.

METHODS

This hospital-based descriptive study was conducted in the Department of Otorhinolaryngology, Head & Neck Surgery, and Department of Microbiology of Gandaki Medical College, Pokhara, Nepal from July 2019 to June 2020. Ethical clearance was obtained from the Nepal health research council ethical review board (Reg. no.735/2018) prior to the study. The written informed consent was obtained from the patient or the patient's party in case of a minority after fully explaining the details of the study, its implications, and importance. The sampling technique was employed as a non-probability convenience method. The sample size was calculated by using the formula $\mathbf{n} = Z^2 \times p \times (1-p)/ d^2$ Where **Z** = is standard normal variate (at 5% type 1 error

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(P<0.05) which is 1.96. Prevalence (P) of CSOM in Nepal is 7.4%.[4] Absolute error or precision (d) decided is 5% so that its value becomes 0.05. Our sample size was 1.96^2 x 0.074 (1-0.074) / 0.05= 105.24. For the convenience, total sample size was set to 120. Patients who satisfy the diagnosis of CSOM (mucosal) by a history of ear discharge for 12 week and perforation in pars tensa were included in the study. The study group did not receive any topical or systemic antibiotics for at least 72 hours before sample was collected. Patients with CSOM who received antibiotics within 72 hours prior to the sample collection, CSOM with atticoantral type, CSOM with ongoing otitis externa, CSOM with any local or systemic complications, preauricular abscess, mastoiditis, or mastoid abscess, labyrinthitis, lateral sinus thrombophlebitis extradural abscess, subdural abscess, brain abscess, or meningitis were excluded from the study. A case report form was used to document the specific history and focused examination.

Cleaning of the external auditory canal was done by either suctioning or dry mopping or both. Pus was collected with sterile swab through the perforation of tympanic membrane under an aseptic condition with sterile Shea aural speculum in the external auditory canal. The sample was labelled and immediately transferred to the microbiology lab with a requisition form for culture/ sensitivity test according to the Clinical and Laboratory Standards Institute (CLSI) 2014 guideline.[5] The swab was cultured in Blood agar, MacConkey agar and incubated at 37°C for 24-48 hours. The isolates grown were identified according to standard microbiological and biochemical tests. Antibiotic susceptibility test was done by Kerby Baur method (disk diffusion method) following the CLSI guideline. Antibiotics included were amikacin, amoxicillin, amoxicillin plus clavulanate, cefixime, cefpodoxime, ceftriaxone, doxycycline, gentamicin, imipenem, ofloxacin and vancomycin. The report was collected from the microbiology lab after 48 hours.

The data were collected on paper-based forms, then entered into Microsoft Excel 2016. Analysis was performed by using SPSS Version 26.0 for windows. Descriptive statistics were used to describe the frequency as percentage, mean and standard deviation.

RESULTS

A total of 127 patients were included in this study. The socioeconomic class was made according to modified Kuppuswamy's socio-economic status,[6] showed highest prevalence of the disease among upper lower socioeconomic class (34.6%), followed by lower (22.8%) and lower middle (20.5%) socioeconomic class. Unilateral CSOM was the most common 121 (95.3%) disease while 6 (4.7%) had bilateral CSOM. Perforation involving all the four quadrants was the most common 21.3%, followed by 3 quadrants perforation (anterior superior, inferior and posterior inferior quadrant) 19.7% (Table 1).

Table 1. Demographic and clinical finding of the patients with CSOM.

Age in year	Range	7 - 69 years
	Mean +/- SD	30.9 ± 15.86
Sex	Female	79
	Male	48
	Female: Male	1.64
Modified Kuppuswamy's socioeconomic status	Lower	22.8%
	Upper lower	34.6%
	Lower middle	20.5%
	Upper middle	16.5%
	Upper	5.5%
Laterality	Right ear	47.3%
	Left ear	48%
	Bilateral	4.7%
Site of perforation	PS+PI	8.7%
	AI	10.2%
	PI	10.2%
	AS+AI	11.8%
	AI+PI	18.1%
	AS+AI+PI	19.7%
	AS+AI+PI+PS	21.3%

Pus from middle ear swab showed positive culture in 107 (84.3%) samples while (15.7%) sample had no growth. *Staphylococcus aureus* 46 (43%) was the commonest isolate among the positive growth, followed by *Pseudomonas aeruginosa* 25(23.4%) (Table 2).

Table 2. Distribution of isolates.

Isolates	Frequency	Percentage
Staphylococcus aureus	46	43%
Pseudomonas aeruginosa	25	23.4%
Proteus mirabilis	10	9.3%
Escherichia coli	9	8.4%
Klebsiella pneumoniae	8	7.5%
Acinetobacter baumannii	4	3.7%
Klebsiella oxytoca	3	2.8%
Citrobacter freundii	2	1.9%
Total	107	100.0%

All isolates were 100% sensitive to imipenem, followed by 96.2% to gentamicin and 95.3% to amikacin. However, amoxicillin alone or combination of amoxicillin and clavulanate showed 8.4% resistant (Table 3).

Table 3. Antibiotic susceptibility pattern of isolates.

Antibiotic	Sensitivity%
Imipenem	100%
Gentamicin	96.2%
Amikacin	95.3%
Ofloxacin	88.78%
Doxycycline	83.2%
Vancomycin	83.2%
Ceftriaxone	78.5%
Cefpodoxime	69.2%
Cefixime	64.5%
Amoxicillin	8.4%
Amoxy-clavulenic acid	8.4%

Staphylococcus aureus was largely sensitive to almost all of the antibiotics except amoxicillin and its combination with clavulanic acid. *Pseudomonas aeruginosa* on the other hand was 100% sensitive to amikacin, gentamycin, and imipenem, in contrast amoxicillin was found to be 100% resistant to *Pseudomonas aeruginosa* (Table 4).

Table 4. Isolate wise antibiotic sensitivity

	Amikacin	Amoxicillin	Amoxicillin + Clavulanate	Cefixime	Cefpodoxime	Ceftriaxone	Doxycycline	Gentamicin	Imipenem	Ofloxacin	Vancomycin
Acenetobacter baumanni	100%	25%	25%	100%	100%	100%	100%	100%	100%	100%	100%
Citrobacter freundii	100%	50%	50%	100%	100%	100%	0%	100%	100%	100%	50%
Escherichia coli	100%	0%	0%	77.8%	77.8%	77.8%	100%	77.8%	100%	100%	100%
Klebsiella oxytoca	66.7%	0%	0%	100%	100%	100%	100%	100%	100%	100%	66.7%
Klebsiella pneumoniae	100%	0%	0%	50%	62.5%	100%	100%	100%	100%	100%	62.5%
Proteus mirabilis	100%	0%	0%	0%	10%	20%	90%	100%	100%	100%	90%
Pseudomonas aeruginosa	100%	0%	0%	40%	44%	60%	40%	100%	100%	56%	76%
Staphylococcus aureus	91.3%	15.2%	15.2%	84.8%	89.1%	93.5%	100%	95.7%	100%	87%	87%

DISCUSSION

Chronic suppurative otitis media often begins as secondary to previous acute otitis media with a spontaneous tympanic perforation, or otitis media with effusion in childhood.[7] The inadequate public health policies, poverty, ignorance, and unavailability of a specialist in many poor resource countries have a high prevalence of CSOM. Chronic suppurative otitis media (CSOM) is one of the major causes of acquired hearing loss in children, more commonly in developing countries. It affects the development of speech and learning in children, in other hand, it hampers quality of life among adult.[8] Resistant strains of bacteria have emerged through excessive and haphazard utilization of antibiotics.[9] The prevalence of microbial flora and their antibiotics susceptibility pattern differs with time and geographical location. This necessitates the microbiological culture and its antibiotic sensitivity in chronic suppurative otitis media.

The female-male ratio was 1.6 in our study. Similar ratio 1.2 was observed by Lakshmi et al.[10] The preponderance of females over male patients may be only an incidental finding as a convenience method of sampling was used. Unilateral CSOM (95.3%) was found to be more common in our study which was marginally lower than the study by Ghosh et al[9] (96.3%), but was higher than in the study Wahid et al[11] (68. 07%).The perforation of the tympanic membrane involving all four quadrants was most common (21.3%) which was slightly lower than findings in the studies done by Kumar et al (32.8%).[12] Our study

showed that CSOM was highest among upper lower class (36.4%), which was lower than the study by Parmar et al[13] with (42.10%) disease among the same class.

In our present study, (84.3%) samples were culture positive which was slightly higher than the study conducted in Bir Hospital Nepal (82.6%).[14] Among 15.7% isolates had no growth which is attributed to anaerobic bacteria, fastidious bacteria, presence of antimicrobial enzymes i.e. lysozyme with immunoglobulins that suppress the bacterial growth, and use of prior antibiotic.[15]

Staphylococcus aureus was the most predominant isolate, (43%) in our study. Similar finding was reported by studies conducted by Vaidya et al. [16] The high frequency of Staphylococcus aureus can be attributed to its ubiquitous nature and habitant of nares.[17] *Pseudomonas aeruginosa* was second most common isolate. However, it was most common isolate reported by Dayasena et al.[18] *Pseudomonas spp*. and *Proteus spp*. gain access to the middle ear from the external ear following the defect in the tympanic membrane resulted from an acute episode of otitis media. Hence these are considered secondary invaders.[19]

The isolates like *E. coli* and *Klebsiella spp*. may enter the middle ear due to bathing and swimming in fecal and urine contaminated water. In this study, (100%) isolates were sensitive to imipenem, followed by gentamicin (96.2%) and amikacin (95.3 %). A study conducted by Jha et al found similar sensitivity, (100%) of imipenem, (94.9%) of amikacin, (89.7%) of gentamicin, (87.2%) of ofloxacin.[20] However, in the meta-analysis performed by Amiri-Andy et al, gentamicin was most sensitive (86%).[21]

Amoxicillin with clavulanate was the least sensitive antibiotic (7.1%) in our study. Three major isolates *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Escherichia coli* were (100%) resistant to it. Ninety percent of isolates showed resistance to amoxicillin in study by Malkappa et al.[22]

Staphylococcus aureus was (100%) sensitive to doxycycline and imipenem, (95.7%) to gentamicin and (87%) to vancomycin. Mehta et al[23] reported sensitivity of doxycycline (95.28%), imipenem (97.17%), gentamicin (96.23%), and vancomycin (98.11%) which was similar to our finding. A study conducted in eastern, Nepal reported lower sensitivity of the gentamicin sensitivity of (73.5%).[24] Our study showed sensitivity of *Staphylococcus aureus* to ofloxacin was (87%) while Okesela et al in Nigeria, had higher sensitivity of ofloxacin (100%).[25]

Pseudomonas aeruginosa was (100%) sensitive to imipenem, gentamicin, and amikacin while the study by Fatima et al too reported slightly lower sensitivity of *Pseudomonas aeruginosa* to imipenem (95%), amikacin (91%), and gentamicin (79.43%) when compared to our findings.[8] *Pseudomonas aeruginosa* was (76%) sensitive to ofloxacin while a study by Nwabuisi reported higher sensitivity (100%) to ofloxacin.[26] Meanwhile Metri et al reported (75%) sensitivity which is lower than our study.[27] *Proteus mirabilis* was (100%) sensitive to amikacin, ceftriaxone, gentamicin, imipenem, and ofloxacin. Our finding was comparable to study Magdum et al,[28] however Justin et al had lower sensitivity (92.9%).[29] *Escherichia coli* was (100%) sensitive to amikacin, doxycycline, imipenem, ofloxacin, and vancomycin in our study.

This is a hospital-based study that included only the aerobic culture of bacteria. Further research on the culture of anaerobic bacteria is needed as these too have been documented in CSOM with discharging ear. Mycotic isolation was not included in the present study. For bacterial isolation, only Blood agar and MacConkey agar were used. We did not collect the data regarding antibiotics used prior to 72 hours of sample collection. Common drugs like co-trimoxazole, erythromycin, and neomycin were not tested for sensitivity. Furthermore, CSOM atticoantral type was excluded from the study, so the findings do not hold true for CSOM atticoantral type. A large sample size with the culture of both aerobic and anaerobic would be a better representative. Mycotic culture and antibiotic sensitivity with more common drugs should be considered for a stronger study.

CONCLUSIONS

Staphylococcus aureus (43%) was the most predominant isolate followed by *Pseudomonas aeruginosa* (23.4%), *Proteus mirabilis* (9.3%), and *Escherichia coli* (8.4%). Imipenem was the most sensitive antibiotic (100%) followed by gentamicin (96.2%), amikacin (95.3%), and ofloxacin (88.78%). For *Staphylococcus aureus* most of the antibiotics were largely sensitive except amoxicillin which was only 15.2% sensitive. *Pseudomonas* had 100% sensitivity to amikacin, gentamicin, and imipenem.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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