BACTERIOLOGICAL PROFILE AND ANTIMICROBIAL SENSITIVITY OF COMMON EAR INFECTIONS

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ABSTRACT

Infections of the ear are very common worldwide. Ear discharge is one of the commonest symptoms of ear infection. The bacteriological profiles of ear discharge are well documented in developed countries but not in our parts of the world. Local antimicrobial prescribing practices directly affect the antimicrobial resistance profile of bacteria among population in different geographical areas. Therefore it is very important for the clinician to know about local bacteriology and its sensitivity pattern for managing ear infections. From September 2017 to February 2018, a total of 154 patients with ear discharge were included in this study. A majority of the participants fell in the age groups 21 to 40 years (54.5%). The most common clinical diagnosis was chronic suppurative otitis media (CSOM) mucosal active disease found in 138 patients (89.6%) while 16 patients (10.4%) had squamous disease. Out of 154 samples, 97 (63%) showed positive results for aerobic culture. Among those, 73 (75.3%) yielded gram positive organisms, 21 (21.6%) yielded gram negative organisms and 3 (3.1%) showed a mixed growth pattern. The most common isolate was *Staphylococcus aureus* (43.3%) followed by coagulase negative *Staphylococcus (CoNS)* (28.9%), *Pseudomonas aeruginosa* (7.2%), *Klebsiella* (5.1%) and others. Among the gram positive isolates, the maximum sensitivity was observed for vancomycin, amikacin, cloxacillin and cotrimoxazole respectively. Ampicillin had maximum resistance with *Staphylococcus* species. Methicillin resistance was observed in 23.8% of *S. aureus*. The gram negative isolates, though less in number, showed maximum sensitivity to cefepime, imipenem and ofloxacin. Resistance was slightly on the higher side for amikacin and amoxiclav. Hence, for better management, it is always advisable to get a microbiological profile and antibiotic sensitivity test done whenever possible. Patients should then be advised to take the complete course of antibiotic to avoid development of resistance.

KEYWORDS

Antimicrobial sensitivity,
bacteriological profile,
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INTRODUCTION

Infections of the ear are very common worldwide. They constitute a major proportion of the cases seen not only by ENT surgeons but also by paediatricians and general practitioners. Ear infection usually occurs due to inflammation of external or middle ear. Ear discharge is one of the commonest symptoms of ear infection.[1] About 65-330 million people suffer from ear infections worldwide causing significant hearing impairment in around 60 percent of them.[2]

Anatomically, ear is important because of its close proximity to the brain. Infections, if untreated or treated late, may result in intracranial complications leading to high morbidity or mortality. However, early diagnosis and rapid management can reduce both of these.[3] Infections from the nose, paranasal sinuses or the oropharynx can also reach the middle ear through the eustachian tube and affect the tympanic membrane causing variety of symptoms.[4-7]

Ear discharge may be a clinical manifestation of acute suppurative otitis media (ASOM), chronic suppurative otitis media (CSOM) or otitis externa (OE).[8] The aetiology of ear discharge may be bacterial, viral or fungal. The bacteriological profiles of suppurative otitis media are well documented in developed worlds. However, only few studies have been conducted in tropical and subtropical countries. *Pseudomonas aeruginosa, Staphylococcus aureus* and *Streptococcus pneumoniae* have been found to be the major culprits.[9-13]

Local antimicrobial prescribing practices directly affect the antimicrobial resistance profile of bacteria among population in different geographical areas. Therefore it is very important for the clinician to know about local bacteriology and its sensitivity pattern for managing ear infections.[14]

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out at Nepal Medical College and Teaching Hospital (NMCTH), Attarkhel, Kathmandu, Nepal from September 2017 to February 2018. Ethical approval was taken from the Institutional Review Committee (IRC) of NMCTH. Prior informed written consent was taken from all the subjects participating in the study.

All patients presenting with ear discharge and willing to give consent were included in the study. Mycobacterial infections, fungal infections and patients with history of trauma and prior use of antibiotics were excluded. Patients of any age and both genders were included. Aural swabs moistened with sterile normal saline were used to collect samples and transported immediately to lab for culture. Swabs were taken before starting medical treatment. Gram staining was done. Pus swabs were cultured on blood agar, MacConkey agar and chocolate agar. Swabs were processed for the isolation of aerobic bacteria using standard bacteriological procedures, and the organisms grown were identified according to the standard bacteriological methods.[15] All cases showing growth on culture media after 72 hours of inoculation were subjected to antibiotic sensitivity testing by modified Kirby - Bauer disk diffusion method, and the interpretation of results was done by using standard guidelines.[16]

RESULTS

A total of 154 patients with ear discharge were included in the study of which 60 (39%) were males while 94 (61%) were females. Out of 154 samples, 97 (63%) showed positive results for aerobic culture. Positive growth rate was more for males but the difference was not statistically significant (Table 1). The ages of patients ranged from 2 to 65 years with a mean age of 29.2±13.2 years. A majority of the participants fell in the age groups 21 to 40 years (54.5%). However, positive growth rate was more in the age groups ≤ 20 years and > 60 years; though not significant statistically (Table 2). Out of 154 patients, 69.5% belonged to middle socioeconomic class. Religionwise, 60.4% of the patients were *Hindus* and 39.6% were *Buddhists*.

Table 1: Gender distribution of the patients (n =154)

Gender	Total n	Positive n	%	P- value
Male	60	42	70	
Female	94	55	59	0.149
Total	154	97	63	

Table 2: Age distribution of patients with ear discharge (n =154)

Age group	Total n	Positive n	%	P-value
≤20	43	30	70	0.179
21-40	84	54	64	
41-60	23	10	43	
>60	4	3	75	
Total	154	97	63	

The most common clinical diagnosis was chronic suppurative otitis media (CSOM) mucosal active disease found in 138 patients (89.6%) of which 32 (20.8%) had bilateral involvement. Right ear was involved in 61 patients (39.6%) and left ear in 45 (29.2%). The other 16 patients (10.4%) were clinically diagnosed to have CSOM squamous type of disease. Right ear was involved in 7 patients (4.6%) and left ear in 8 (5.2%). One patient (0.6%) had bilateral disease. In both mucosal and squamous variants, positive growth rate was more when the disease was bilateral. In unilateral infections,

right sided disease yielded more positive growth compared to the left. Positive growth rate was more for squamous disease compared to mucosal, however, it was not significant statistically (p=0.414). (Table 3)

Table 3: Clinical diagnosis (n = 154)

Clinical diagnosis		Total n	Positive n	%	P-value
COM mucosal active	Right	61	38	62	
	Left	45	24	53	
	Bilateral	32	23	72	
COM squamous	Right	7	7	100	0.414
	Left	8	4	50	
	Bilateral	1	1	100	
	Total	154	97	63	

Among the 97 positive samples, 73 (75.3%) yielded gram positive organisms, 21 (21.6%) yielded gram negative organisms and 3 (3.1%) showed a mixed growth pattern with both. The most common isolate was *S. aureus* (43%) followed by coagulase negative *Staphylococcus (CoNS)* (29%), *P. aeruginosa* (7%), *Klebsiella* (5%) and others (Table 4).

Table 4: Bacteriological profile of ear discharge

Bacterial isolates		Total n=97	%
Gram positive	*S. aureus*	42	43
	CONS	28	29
	Enterococcus	3	3
Gram negative	*P. aeruginosa*	7	7
	Klebsiella	5	5
	Citrobacter	4	4
	E. coli	3	3
	Proteus mirabilis	2	2
Mixed infection		3	3

Among 42 *S. aureus*, the sensitivity of vancomycin, amikacin, cotrimoxazole, cloxacillin and cephalexin were 100%, 92.8%, 76.2%, 76.2% and 71.4% respectively. Methicillin resistance was observed in 10 (23.8%). Among 28 *CoNS*, the sensitivity of vancomycin, amikacin, cloxacillin, ofloxacin and cotrimoxazole were 100%, 89.3%, 71.4%, 71.4% and 67.8% respectively. *Enterococcus* showed 100% sensitivity to vancomycin, ofloxacin and high level gentamycin (Table 5).

Among gram negative isolates, *Escherichia coli* showed 100% sensitivity to ofloxacin, cotrimoxazole, amoxiclav, cefepime and imipenem. *Klebsiella* showed 100% sensitivity to ofloxacin, cotrimoxazole, cefepime and imipenem. *Citrobacter* showed 100% sensitivity to amikacin and cefepime. *Proteus* was 100% sensitive to cotrimoxazole, ceftriaxone, cefepime and imipenem. *P. aeruginosa* was 100% sensitive to imipenem (Table 6).

Table 5: Antimicrobial sensitivity patterns of gram-positive organisms

	S.aureus (n=42)	*CoNS* (n=28)	*Enterococcus* (n=3)
Ampicillin	16 (38.1%)	13 (46.4%)	1 (33.3%)
Cloxacillin	32 (76.2%)	20 (71.4%)	NT
Ofloxacin	26 (61.9%)	20 (71.4%)	3 (100%)
Cotrimoxazole	32 (76.2%)	19 (67.8%)	NT
Erythromycin	19 (45.2%)	13 (46.4%)	2 (66.6%)
Amikacin	39 (92.8%)	25 (89.3%)	NT
HLG			3 (100%)
Vancomycin	42 (100%)	28 (100%)	3 (100%)
Cephalexin	30 (71.4%)	18 (64.3%)	NT

NT = Not tested

HLG = High level gentamycin (120 Microgram) for *Enterococcus*

Table 6: Antimicrobial sensitivity patterns of gram-negative organisms

	E.coli (n=3)	*Klebsiella* (n=5)	*Citrobacter* (n=4)	*Proteus* (n=2)	*P. aeruginosa* (n=7)
Ofloxacin	3 (100%)	5 (100%)	3 (75%)	1 (50%)	6 (85.7%)
Cotrimoxazole	3 (100%)	5 (100%)	2 (50%)	2 (100%)	3 (42.8%)
Amikacin	2 (66.6%)	4 (80%)	4 (100%)	0 (0%)	6 (85.7%)
Ceftriaxone	2 (66.6%)	4 (80%)	3 (75%)	2 (100%)	6 (85.7%)
Amoxiclav	3 (100%)	4 (80%)	3 (75%)	1 (50%)	5 (71.4%)
Cefepime	3 (100%)	5 (100%)	4 (100%)	2 (100%)	6 (85.7%)
Imipenem	3 (100%)	5 (100%)	3 (75%)	2 (100%)	7 (100%)

DISCUSSION

Although ear infections like otitis externa and acute otitis media also present with ear discharge, most of the patients in our study were found to have clinical diagnosis of chronic suppurative otitis media (CSOM), mucosal and squamous type, with female preponderance. This study was similar to studies by Rakhee T and Panchal PD.[17, 18] A majority of the participants in our study fell in the age group 21 to 40 years (n=84). Studies by Rakhee T, Panchal PD, Bizimana A and Arif D also found similar age group being affected more.[17-20] This could be because young adults are mainly involved in outdoor activities and exposed to humid atmosphere leading to excessive sweating, which is a favourable condition for an infection to set in. However, literature also reveals many other studies where children have been shown to be more affected.[21-23] They argue that shorter and wider eustachian tube in children, breast feeding in supine position and instillation of oil in ears could be the major contributors. In terms of positive growth rate, the age groups ≤ 20 years and > 60 years were more vulnerable. This could be due to the weaker immune system in these groups compared to others.

Our positive growth rate of 63% is comparable to another study done in the same institute seeking bacterial isolates from pus/ wound swab samples.[24] Most of the studies done in India, however, have shown a higher positive growth rate.[17-19] This could be due to variation in laboratory facilities, possible delay in sample transport, omission of anaerobic isolates or inability to elicit proper history regarding prior use of antibiotics. In our study, positive growth rate was more for squamous disease compared to mucosal. Likewise, bilateral infections yielded more positive growth compared to unilateral. However, these differences were not significant statistically. This might hint towards a possible association between severity of the disease process and positive aerobic culture.

The most common isolate in our study was *S. aureus* which was similar to other studies.[13, 19, 23, 25] This could be because of close proximity of the Eustachian tube with upper respiratory tract from where the staphylococcal infection might ascend to middle ear. Whereas, others have found *P.aeruginosa* as the commonest isolate in patients with ear discharge.[17, 18, 20, 26] They argue that the minimal nutritional requirement of *P.aeruginosa* and its virulence factors mainly attribute to ear infections. In our study, however, *P.aeruginosa* was only third most common isolate. This variation of bacterial isolates seen in different studies could be because of difference in climate, geography or ethnicity.

Regarding antimicrobial sensitivity, *S. aureus* showed maximum sensitivity to vancomycin (100%), amikacin (92.8%), cloxacillin (76.2%) and cotrimoxazole (76.2%) respectively. Among *S. aureus*, methicillin resistance was observed in 23.8% of isolates which is comparable to other studies where they found resistance in 18% and 20%.[23, 25] This supports the role of cloxacillin as an empirical antibiotic for ear infections in our localities. The methicillin resistant *S. aureus (MRSA)* were highly sensitive to vancomycin and amikacin.

CoNS was the second most common gram positive isolate in our study which was similar to some other studies.[17, 18, 26] *CoNS* is a normal skin flora so it might be a contaminant which can sometimes become an opportunistic pathogen. Sensitivity of *CoNS* was highest for vancomycin followed by amikacin, cloxacillin and ofloxacin.

In our study, ampicillin had maximum resistance with *Staphylococcus* species (58.6 %), which was comparable to a study done by Agrawal A where they found it to be 61.7%.[25] This eliminates the possibility of ampicillin as an antibiotic of choice to treat ear infections in our communities.

Enterococcus, though less in number, showed 100% sensitivity to vancomycin, ofloxacin and high level gentamycin.

Among the gram positive isolates, the maximum sensitivity was observed for vancomycin, amikacin, cloxacillin and cotrimoxazole respectively.

Among gram negative isolates, *P.aeruginosa* was 100% sensitive to imipenem and 85.7% sensitive to each of ofloxacin, ceftriaxone, cefepime and amikacin. Sensitivity with amikacin (85.7%) was in concordance with some other studies.[25, 27] However, reports of low sensitivity with amikacin are also seen in some studies.[28, 29] Tahir *et al* observed 95% sensitivity with imepenem which is comparable with our study.[28] Sensitivity with quinolones was 61-68% in a study which is much lower to ours, however, others have reported a higher sensitivity of 90-92% which is comparable with ours.[25, 27, 28]

E. coli showed 100% sensitivity to ofloxacin, cotrimoxazole, amoxiclav, cefepime and imipenem. *Klebsiella* showed 100% sensitivity to ofloxacin, cotrimoxazole, cefepime and imipenem. *Citrobacter* showed 100% sensitivity to amikacin and cefepime. *Proteus* was 100% sensitive to cotrimoxazole, ceftriaxone, cefepime and imipenem.

The gram negative isolates, though less in number, showed maximum sensitivity to cefepime, imipenem and ofloxacin. Resistance was slightly on higher side for amikacin and amoxiclav; thereby questioning their gram negative coverage in our communities.

In our study, only 1.9% samples showed mixed infections. The predominance of mono-microbial infection could be due to limited laboratory facilities in our setting, thereby affecting sample collection, transport and sample processing where we didn't consider anaerobiasis.

In Conclusion, the most common cause of ear discharge is chronic suppurative otitis media (CSOM) mucosal active disease. Gram positive organisms are more responsible for causing ear discharge than gram negative organisms. The most common organism is *S. aureus* followed by *CoNS, P. aeruginosa, Klebsiella* and others. For gram positive coverage, cloxacillin, cotimoxazole or amikacin can be used as empirical therapy. Ofloxacin or cefepime offer best empirical coverage for gram negative. However, it is always advisable to get a bacteriological profile and antibiotic sensitivity test done whenever possible. Patients should then be advised to take the complete course of antibiotic to avoid development of resistance. Periodic evaluations of microbial pattern will help find out new emerging resistant strains.

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