ORIGINAL ARTICLE

ISOLATION AND ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF BACTERIAL PATHOGENS CAUSING OTITIS MEDIA IN CHILDREN IN JIMMA HOSPITAL, SOUTHWESTERN ETHIOPIA

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ABSTRACT

BACKGROUND: *Otitis media is one of the commonest diseases of children. In Ethiopia, especially in southwestern regions, there is little information on otitis media in children. The aim of this study was to assess the magnitude and bacterial etiologic agents of otitis media and determine their antimicrobial susceptibility patterns.*

METHODS: *This cross-sectional study was conducted in Jimma University hospital during January 2002- February 2003. Children under 15 years of age consecutively seen in pediatrics out patient department of Jimma University hospital were include in the study. Ear swab specimens were collected and cultured on appropriate media. Bacterial pathogens were isolated and characterized following standard procedures. Identification of the clinical isolates were made using standard methods. Antibiotic susceptibility tests against commonly prescribed antimicrobial agents were carried out following standard disc diffusion methods.*

RESULTS: *A total of 154 patients (79 males and 75 females) aged 2 months to 15 years were included in the study. Eighty-nine (57.8%) of the patients were under five years, while 65 (42.2%) were 5 and above years of age. Seventy-five (49.6%) of the patients were referred from other health institutions. Forty-nine (32.0%) children had history of use of antibiotics 2 weeks prior to hospital visit. Of the total patients, 62(40.3%) had acute and 92(59.7%) chronic otitis media. A total of 163 bacterial strains were isolated from the 154 children. Of the isolates, Proteus species 55 (33.7%), Staphylococcus aureus 24 (14.7%), Pseudomonas aeruginosa, 18 (11.0%), predominated followed by Staphylococcus epidermidis, 14 (8.6%), Klebsiella spp, 13 (8.0%) Streptococcus pyogenes, 13 (8.0%), E. coli, 5 (3.1%), H. influenzae, 3(1.8%) Citrobacter freundii, 3(1.8%), Streptococcus pneumoniae, 2(1.2%) and Enterobacter species, 1(0.6%). The prevalence of otitis media was higher (17.5%) on children less than 2 years old. All bacterial isolates were sensitive to ciprofloxacin and gentamicin susceptibilities of Pseudomonas, Klebsiella and E. coli was 100%. All isolates of Klebsiella, E. coli, and Citrobacter spp were resistant to ampiciliin. Eighty four percent of S aureus isolates were resistant to penicillin and 20.0% to methicillin while 23.4% of S. epidermidis isolates were resistant to methicillin.*

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CONCLUSION: ***Ear infections should be diagnosed and treated early by effective drugs before they cause hearing problems. Gentamicin was highly effective antibiotic in 86.4-100% against Gram negative bacterial clinical isolates and thus should be considered in treating patients with otitis media.***

KEY WORDS: Otitis media, children, antimicrobial agent, bacteria, Jimma

INTRODUCTION

Otitis media, especially the acute form, is a common disease of children with high morbidity (1). Both acute and chronic otitis media are the major health problems in children in developing countries (2). Otitis media is common between the ages of 6 months and 3 years, but acute otitis media (AOM) is one of the most frequent diagnoses in children under two years of age.

Acute otitis media is rapid with short onset of signs and symptoms of inflammation in the middle ear, which has one or more of the following presentations: otalgia, fever, irritability (3). Chronic suppurative otitis media (CSOM) is a chronic inflammation of the middle ear and mastoid process with perforated tympanic membrane in which patients have ear discharge for more than 2 weeks (4,5). CSOM is characterized by recurrent or persistent ear discharge (ottorhoea).

Different investigators (2) indicated the frequent prevalence of bacteria like *S. pneumoniae, H. influenzae,* and *Moraxella catarrhalis* in acute otitis media. Chronic suppurative otitis media (CSOM), is a chronic inflammation of the middle ear and mastoid process with perforated tympanic membrane and ear discharge persisting for two weeks (4). It occurs as a complication of acute otitis media due to inadequate or failure of treatment. COSM may cause permanent damage to the ear such as hearing loss leading to delayed speech development and impaired cognitive functioning as well as other disabilities due to central nervous system (CNS) involvements. Economically, it incurs high cost for treatment.

Of the total 158 bacteria isolated in a study conducted in Ethio-Swedish Pediatric hospital in Addis Ababa, Proteus spp (31.0%), *S. aureus* (18.0%), *E. coli* (16.0%), Klebsiella spp (12.0%), Pseudomonas spp (6.0%) were the main pathogens detected. Multi-drug resistance was noted in the study (5,6). In another study in the same city, Klebsiella spp (29.0%), *E. coli* (10.7%), diphtheroids (7.3%), acinetobacter (4.7%), *S. epidermidis* (4.5%), *Proteus vulgaris* (43.0%), *S. aureus* (3.6%) and citrobacter (3.6%) were isolated. In this study, a total of 2334 patients with ear problems were investigated and about 70.0% of them had otitis, while the rest had other ear problems including otitis externa, wax, tinnitus. Of the total patients seen, 52.8% had chronic and 4.1% had acute otitis media (7).

Antibiotic resistance is increasing worldwide. Penicillin resistant *S. pneumoniae* strains are isolated in different countries. *Haemophilus influenzae* becomes a common pathogen in young children especially under the age of 4 years (8). In addition, the anti-microbial resistance pattern of these isolates is not well documented. Some antibiotics like tetracycline, sulfonamides, trimethoprim and chloramphenicol (9) are not recommended to treat streptococcal infections because of the problems of resistance. Furthermore, the number of beta-lactamase producing bacterial strains are increasing gradually (11-15).

In general, there are several cases of upper respiratory tracts infections and otitis media among children (10). However, there

is very little information about the isolation (11) and characterization of potential bacterial pathogens from ear infections in Ethiopia. Hence, there is a strong need to generate data on prevalence of bacterial pathogens in ear infections.

In Ethiopia in general and Southwestern regions, there is little information on otitis media in children. The purpose of this study, therefore, was to isolate and characterize the bacterial etiologic agents of otitis media in Jimma, and determine their susceptibility patterns to commonly used antimicrobial agents in order to optimize therapeutics for this disease.

PATIENTS AND METHODS

Patients: This cross-sectional hospital-based study was conducted at Jimma university hospital and Department of Microbiology laboratory of Jimma University during January 2002 and February 2003. Ear swab specimens were collected from 154 consecutively seen children at Jimma University hospital out patient department that were clinically diagnosed as having otitis media. The specimens were collected by experienced health workers with standard sterile, cotton-buds and were immediately inoculated on to appropriate culture media. In addition, all required information regarding medical history, clinical findings, demographic and other data of the patients were taken filled into a prepared questionnaire by assigned physicians.

Laboratory procedures: Ear swabs were simultaneously inoculated into nutrient broth, trypticase soy agar, MacConkey, mannitol salt agar, blood agar and chocolate agar media to isolate the bacterial pathogens from clinical specimens. Plates were incubated at 37^{0}C for 18 hours and were examined in the next day for growth of bacteria. Organisms were isolated and characterized following standard procedures for both gram-negative and positive organisms (4,8). This was done using Gram's staining, culture for morphology and characteristics (haemolysis on 5% sheep blood agar), motility test, biochemical test, coagulase, catalase, oxidase test, bacitracin, optochin sensitivity tests.

Antimicrobial susceptibility tests: The antimicrobial susceptibility patterns of major Gram positive and negative bacterial isolates obtained from clinical specimens was determined using different panels of antibiotics.

A McFarland 0.5 turbidity standard was used to adjust the inoculum. The test organism was grown in nutrient broth and incubated for 6 hours. It was evenly spread, on Mueller Hinton agar, and then, antibiotic discs were placed on the media and incubated for about 18 hours.

The antimicrobial agents employed (Oxoid, Basingstoke, Hampshire, England) were penicillin (100 iu), ampicillin (10 µg), cephalothin (30 µg), methicillin (5 µg), cloxacillin (5 µg), co-trimoxazole (25 µg), kanamycin (30 µg), doxycycline (30 µg), chloramphenicol (30 µg), amikacin (30 µg), clindamyci (10 µg), polymyxin B (300 µg), as well as (Span Diagnostics, India) gentamicin (10 µg) and ciprofloxacin (5 µg). This was carried out following methods outlined by Bauer *et. al* (16). The antibiotic susceptibility profiles of the commonly prescribed antimicrobial agents were studied in accordance with the principles established by 'National Committee for Clinical Laboratory Standards' (NCCLS) (17). *E. coli* and *S. aureus* strains for quality control were also used.

Ethical Considerations: Concerned authorities of the hospital and department were officially informed about the study. Further more, ethical clearance was obtained from the research and publications

office of Jimma University. Parents of the study subjects were briefed about the study and verbal consent was obtained. Laboratory results were forwarded to the responsible physician and patients were treated according to the antimicrobial sensitivity test results.

RESULTS

A total of the 170 children were recruited for the study. Of this, 154 children with otitis media were investigated making an attendance rate of 90.0%. The rest 16 (10%) children were excluded due to dry ears and incomplete data. There were 79 (51.3%) males and 75 (48.7%) females. The male to female sex ratio was 1.05:1. The mean age of the children was 4.8 years (range 2 months -15 years). Of the total patients, 129 (83.8%) were from urban setting of Jimma town and the rest 25 (16.2%) came from rural areas. About half (49.4%) of the patients had previously visited other health institutions and were referred from these health centers and clinics while the rest came without being referred. Forty-nine (31.8%) children had history of use of antibiotics 2 weeks earlier / prior to visiting the hospital. Eighty-nine (57.8%) of the patients were under five years, while 65 (42.2%) were 5 and above years of age. Of the under five patients, 11 (7.1%) were below one year and 78 (50.1%) were aged 1-4 years (Table 1). About two third (65.6%) of the families were from poor families earning less than 300 Birr /month (less than 1 US Dollar /day).

Table 1. Socio-demographic characteristics of children studied, January 2002- February 2003 Jimma Hospital

Characteristic	Number	Percent
Sex		
Male	79	51.3
Female	75	48.7
Age at presentation (years)		
<1	11	7.1
1-4	78	50.7
≥ 5	65	42.2
Age range (years)	2 mo-15 y	
Mean age (years)	4.8 years	
Address		
Urban (Jimma Town)	129	83.8
Rural (Outside Jimma)	25	16.2
Occupation of parents		
Farmer	22	14.3
Civil servants	50	32.5
Merchant / Private job	40	26.0
No job	29	18.8
Daily laborer	6	3.9
No information given	7	4.5
Total	**154**	**100.0**

Majority of the patients with chronic otitis media, 53/92 (57.6%) were referred from lower level health institutions while, 23/62 (37.1%) of the patients with acute otitis media were referred. Of those who came from urban area, 72/129 (55.8%) had chronic otitis media and those who came from rural areas had higher [20/25 (80.0%)] prevalence of chronic otitis media. This could be due poor or lack of access to health services and low socioeconomic conditions.

On clinical examination, patients with acute otitis media exhibited pharyngitis, pneumonia, fever and otalgia (data not shown). Of the total 154 patients screened, 62(40.3%) had acute and 92(59.7%) had chronic otitis media (Table 2). More males, 33/62 (53.2%) had acute otitis media than females, 29/62 (46.8%). This is not statistically significant. On the other hand, an equal number of males and females had chronic otitis media, i.e. 46/92 (50.0%) for both sexes. Of the chronic otitis media cases, ear discharge was recurrent in 74/92 (80.4%) while only 18 (19.6%) were persistent.

The highest frequency or maximum infectivity rate was observed at age 2 years, which constituted of 27/154 (17.5%) followed by 3 years 19/154 (12.3%). A total of 163 bacterial strains were isolated from 133 specimens of the tested. No specific bacterial species was isolated in 14/154 (9.1%) and fungal contaminants were isolated from 5 (3.2%) of the cases.

Table 2. Clinical and Lab diagnosis of children with ear infections, in relation to sex, age and address, January 2002- February 2003, Jimma Hospital

Characteristic	AOM (n = 62) No (%)	COM (n =92) No (%)	Total (n =154) No (%)
Sex			
Male	33 (53.2)	46 (50.0)	79 (51.3)
Female	29 (46.8)	46 (50.0)	75 (48.7)
Age (year)			
<1	9 (14.5)	2 (2.2)	11 (7.1)
1-3	24 (38.7)	36 (39.1)	60 (39.0)
4-6	17 (27.4)	20 (21.7)	37 (24.0)
7-9	4 (6.5)	19 (20.7)	23 (14.9)
10-12	6 (9.7)	8 (8.7)	14 (9.1)
13-15	2 (3.2)	7 (7.6)	9 (5.8)
Address			
Urban	57 (91.9)	72 (78.3)	129 (83.8)
Rural	5 (8.1)	20 (21.7)	25 916.2)
Referred from other health institution	23 (37.1)	53 (57.6)	76 (49.4)
Self referred	39 (62.9)	39 (42.4)	78 (50.6)

AOM: acute otitis media; COM: Chronic otitis media

Of the 163 identified bacterial isolates, 103 (63.2%) were Gram negative, while 60 (36.8%) were Gram-positive. From the positive cultures the following bacterial species were obtained: *Proteus spp (Proteus mirabilis, P. vulgaris, P. penneri, P. retgerri), Staphylococcus spp (S. aureus, S. epidermidis), Pseudomonas aeruginosa, Klebsiella spp (K. pneumoniae, K, oxytoca), Streptococcus species (S. pyogenes, Streptococcus pneumoniae),* Gram negative rods *(E. coli, Citrobacter freundii, H. influenzae)* and *Diphtheroids* (Table 3). Of the acute otitis media cases, the commonest pathogens isolated were *S. epidermidis*: (6.7%), *Proteus mirabilis*: (6.1%), *Staphylococcus aureus,* (6.1%), *S. pyogens:* (4.9%), K. *pneumoniae* (3.1%) and *Pseudomonas aeruginosa* (3.1%).

The following pathogens were isolated from chronic otitis media in decreasing order: *Proteus mirabilis* (20.9%), *S aureus* (8.6%), *Pseudomonas aeruginosa* (8.0%), *Klebsiella species* (4.3%) isolates, followed by *S. pyogenes* (3.1%), *E. coli* (2.5%). Overall isolates from both acute and chronic otitis media included all Proteus species consisting of *(Proteus mirabilis, P. vulgaris, P. penneri, P. retgerri),* 55/163 (33.7%), *S aureus,* 24(14.7%), *Pseudomonas aeruginosa* 18(11.0%), *S. epidermidis* 14(8.6%), *Klebsiella species* 13 (8.0%), *S. pyogenes* 13 (8.0%), *E. coli* 5(3.0%) *H. influenzae* 3(1.8%), *Citrobacter freundii* 3(1.8%), *S. pneumoniae* 2 (1.2%), *Enterobacter cloacae* and *S. haemolyticus* 1(0.6%) each. Other isolates 11(6.7%) included unidentified gram positive and negative cocci and rods as well as diphtheroids species. In addition, no bacterial growth was detected in 14/154(9.1%) and Yeast /fungal contaminants were isolated in 5/154 (3.2%). Thus, bacterial agents were isolated from 135 (87.7%) of the cases.

Table 3. Patterns of isolation of pathogens from acute and chronic ear infections in children, Jimma hospital, January 2002- February 2003

Organism isolated	AOM No (%)	COM No (%)	Total No (%)
Gram negative bact (103)			
Proteus mirabilis	10 (6.1)	34 (20.9)	44 (27.0)
Proteus vulgaris	2 (1.2)	7 (4.3)	9 (5.5)
Other Proteus spp*	0 (0)	2 (1.2)	2 (1.2)
Pseudomonas aeruginosa	5 (3.1)	13 (8.0)	18 (11.1)
Klebsiella pneumoniae	5 (3.1)	5 (3.1)	10 (6.2)
Klebsiella oxytoca	1 (0.6)	2 (1.2)	3 (1.8)
Escherichia coli	1 (0.6)	4 (2.5)	5 (3.1)
Citrobacter freundii	1 (0.6)	2 (1.2)	3 (1.8)
Heamophilus influenzae	1 (0.6)	2 (1.2)	3 (1.8)
Enterobacter cloacae	0 (0)	1 (0.6)	1 (0.6)
Other (Unidentified Gr -ve cocci	0 (0)	2 (1.2)	2 (1.2)
Unidentified Gr -ve rods	2 (1.2)	1 (0.6)	3 (1.8)
Gram positive bact (60)			
Staphylococcus aureus	10 (6.1)	14 (8.6)	24 (14.7)
Staphylococcus epidermidis	11 (6.7)	3 (1.8)	14(8.5)
Streptococcus pyogenes	8 (4.9)	5 (3.1)	13 (8.0)
Streptococcus pneumoniae	1 (0.6)	1 (0.6)	2 (1.2)
Staphylococcus haemolyticus	1 (0.6)	0 (0)	1 (0.6)
Diphtheroids spp G+rods	2 (1.2)	0 (0)	2 (1.2)
Unidentified G+ cocci	3 (1.8)	1(0.6)	4 (2.5)
Total	64 (39.3)	99 (60.7)	163 (100)

Other *Proteus spp*: Proteus penneri, Proteus retgerri*

Number increased than culture number due to more one bacterial isolation in some cultures

Mixed infections were detected as depicted in Table 4. Pure or single bacterial isolation was found in 108(70.1%) and mixed, (i.e 2 or 3 organisms) were found in 31/154 (20.1%). In mixed (Double and triple) infection, the most frequent combinations were:

P. mirabilis plus Pseudomonas spp as well as *P. mirabilis* plus Klebsiella spp where they were isolated in 4 clinical specimens each.

P. mirabilis plus *S. aureus* combinations were isolated from 2 different patients.

Triple infection: *P. vulgaris* plus *S. pyogenes* plus Enterobacter as well as *P. mirabilis* plus *S. aurues* plus Pseudomonas were isolated from one patient each.

The remaining 13 combinations appeared in single patients each.

Proteus mirabilis and *Pseudomonas aeruginosa* as well *Proteus mirabilis* plus *Klebsiella spp* were the commonest combinations found mixed (frequency 4 incidents/ times) followed by *Proteus mirabilis* plus *S. aureus*, (both in 2 occasions).

Clinical isolates of ear pathogens were susceptibility tested against different antimicrobial agents. The in vitro activities of common antibiotics is shown in Table 5.

Two panels of antibiotics were used for Gram-positive and Gram-negative isolates. All isolates (both gram positive and negative) were sensitive to ciprofloxacin. All isolates of Pseudomonas, Klebsiella species and *E. coli* were sensitive to gentamicin (Table 5). In general, gentamicin was effective antibiotic (86.4%-100%) against gram-negative bacterial clinical isolates. Cephalothin and gentamicin were also effective drugs against Gram-positive bacteria (80-100%). All isolates of Klebsiella species, *E. coli*, and Citrobacter spp were resistant to ampiciliin. Of the *S aureus* isolates, 84.0% were resistant to penicillin and 20.0% were resistant to methicillin while 23.4% of *S. epidermidis* isolates were resistant to methicillin. All *S. pneumoniae* strains were susceptible to penicillin.

Concerning multidrug resistance, the following were highly resistant (resistance >80%) of case. *P. aeruginosa* showed resistance to doxycycline, ampicillin and and chloramphenicol. *S. aureus* was resistant to pen, ampicilli, in >80% of case. *P. vulgaris* was resistant to polymyxin, and doxycycline, in >80% of case. *P. mirabilis* was resistant to polymyxin, and doxycycline. No penicillin resistant *S. pneumoniae* was detected.

Table 4. Frequency, polymicrobial isolation (n = 154 cultures)

Type of cultural isolation	Acute otitis media n (%)	Chronic otitis media n (%)	Total n (%)
Single	41 (26.6)	69 (44.8)	110 (71.4)
Double	11 (7.1)	16 (10.4)	27 (17.5)
Triple	0 (0)	3 (1.9)	3 (1.9)
Other (Fungi)	4 (2.6)	2 (1.3)	6 (3.9)
No growth	6 (3.9)	2 (1.3)	8 (5.2)
Total	62 (40.3)	92 (59.7)	154 (100.0)

Table 5. Pattern of susceptibility of bacterial species from clinical isolates to specific antimicrobial agents, January 2002- February 2003, Jimma Hospital

Bacteria	Antimicrobial agents tested									
Gram negative	SXT	Gent	Kana	Amik	Cipr	PB	Amp	Ceph	Chlo	Doxy
P. mirabilis (44)	28 (63.6)	38 (86.4)	26 (59.1)	43 (97.7)	44 (100)	2 (4.5)	16 (36.4)	30 (68.2)	12 (27.3)	2 (4.5)
P. vulgaris (9) §	4 (44.4)	8 (88.9)	9 (100)	9 (100)	9 (100)	0 (0.0)	4 (44.4)	5 (55.6)	4 (44.4)	1 (11.1)
P. aeruginosa (18)	8 (44.4)	18 (100)	10 (55.6)	17 (94.4)	18 (100)	8 (44.4)	4 (22.2)	7 (38.9)	4(22.2)	3 (16.7)
Klebsiella spp** (13)	7 (53.9)	13 (100)	8 (61.5)	12 (92.3)	13 (100)	10 (76.9)	0 (0.0)	7 (53.9)	9 (69.2)	7 (53.9)
E. coli (5)	3 (60.0)	5 (100)	4 (80.0)	5 (100)	5 (100)	4 (80.0)	0 (0.0)	1 (20.0)	4 (80.0)	1 (20.0)
Citrobacter spp (3)	2 (66.7)	3 (100)	3 (100)	3 (100)	3 (100)	2 (66.7)	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)
Gram Positive	Pen	Gent	Kana	Clind	Cipr	Meth	Amp	Ceph	Chlo	Doxy
S. aureus (24)	3 (12.5)	23 (95.8)	20 (83.3)	17 (70.8)	24 (100)	19 (79.2)	4 (16.7)	21 (87.5)	17 (70.8)	9 (37.5)
S. epidermidis (14)	10 (58.8)	14 (100)	12 (88.2)	13 (94.1)	14 (100)	10 (76.5)	6 (52.9)	13 (94.1)	7 (58.8)	7 (58.8)
S. pyogenes (10)	10 (100)	8 (80.0)	0 (0.0)	8 (80.0)	10 (100)	8 (80.0)	10 (100)	9 (90.0)	9 (90.0)	7 (70.0)
S. pneumoniae (2)	2 (100)	2 (100)	2 (100)	2 (100)	2 (100)	2 (100)	1 (50)	2 (100)	1 (50.0)	1 (50.0)

*SXT: Trimethoprim-sulfamethoxazole; Gent: gentamicin; Kan: kanamycin; Amik: amikacin; Cipr: Ciprofloxacin; PB: polymyxin B; Amp: ampicillin; Pen: penicillin; Chlo: chloramphenicol; Doxy: doxycycline; Meth: methicillin; Ceph: cephalothin; Clind: clindamycin

** Because of small numbers, some specific species are lumped together as spp

** Because of small numbers, all species are not indicated here.

§2 spp of proteus (*Proteus penneri* and *Proteus retgerri*) were not tested.

DISCUSSION

Otitis media is the major health problem in children in developing countries (2). It is more common in children because of the short and narrow Eustachian tube. Most cases of otitis media arise between the ages of 6 months and 3 years. These syndromes basically initiated by a variety of upper respiratory tract cases which lead to impaired middle ear physiology (1, 2). Thus, it results from a complication of upper respiratory tract infection. These conditions embody upper respiratory tract infections, allergy and all other cases leading to Eustachian tube malfunction.

In the present study, 33/62 (53.2%) of the male patients had acute otitis media than females, 29/62 (46.8%). This difference is not statistically significant. On the other hand, an equal number of males and females were affected by chronic otitis media, i.e. 46/92 (50.0%) for both sexes. This is similar to reports Teele et al (18).

S. epidermidis, S. pyogenes, S. aureus and *Proteus mirabilis* accounted for high number of isolates in acute otitis media in the present study unlike the studies conducted in the temperate zones, where *S. pneumoniae, H. influenzae* and *Moraxella catarrhalis* are the most important causes of acute otitis media. This could be due to higher temperature and its presence in the skin in abundant number, which can easily get access to the ears. On the other hand, *Proteus spp, S. aureus* and *Pseudomonas aeruginosa* are the leading causes of chronic otitis media in the present study. This is similar to a study conducted in Tanzania by Moshi et al (2) who found that *Pseudomonas aeruginosa, S. aureus* and *Proteus mirabilis, Klebsiella spp, E. coli* were the major isolates in chronic otitis media cases. The finding is not much different from earlier studies conducted in Ethio-Swedish Pediatric hospital in Addis Ababa, which showed *Proteus spp* (31%), *S. aureus* (18%), *E. coli* (16%), *Klebsiella spp* (10%), and *Pseudomonas spp* (6%) were the commonest bacterial isolates from chronic otitis media (7).

In another study *Klebsiella spp* (29%), *E. coli* (10.7%), *diphtheroids* (7.3%), *acinetobacter* (4.7%), *S. epidermidis* (4.5%), *Proteus vulgaris* (43%), *S. aureus* (3.6%) and *Citrobacter spp* (3.6%) were isolated. Of a total of 2334 patients with ear problems about 70% had otitis while the rest had other ear problems including otitis externa, wax, tinnitus. Of the total patients seen, 52.8% had chronic while 4.1% had acute otitis media (7).

A considerable number of fungal isolates were also identified mixed with bacterial species in the ear swabs. This could be due to prolonged and inappropriate uses of antibiotics. Other laboratory results revealed that no bacterial organisms were isolated, ie., these infections could be caused by viral agents. Anaerobic bacterial agents and mycobacterial species could not be excluded since no tests were done for these.

There were higher number of chronic otitis media as compared to the acute condition. This could be due to low socioeconomic status and poor health service deliveries and treatment failures along with incomplete treatment of acute otitis media.

Multi-drug resistance, i.e. resistance to 2 or more antimicrobial agents was noted. The following were highly resistant (resistance > 80%) of case. *P. aeruginosa* showed resistance to doxycycline, ampicillin and and chloramphenicol. *S. aureus* was resistant to penicillin and ampicillin in >80% of case. There was also 20% and 84.0% resistance of *S. aureus* to methicillin and penicillin respectively. Of the *S. epidermidis* isolates, 23.4% of them were resistant to methicillin. This is an alarming situation. In another case, there was no penicillin resistant *S. pneumoniae* detected. All gram positive and negative isolates were sensitive to ciprofloxacin. Although this antibiotic has bone marrow depression effects in young children, the antimicrobial has good effect on multidrug resistant pathogens. All isolates of *Pseudomonas, Klebsiella* species and *E. coli* were sensitive to gentamicin. This agrees with the fact that aminoglycosides are more effective than other broad spectrum antimicrobials including the quinolones despite their toxic adverse effects when administered for more than 2 weeks (19). *P. vulgaris* was resistant to polymyxin B and doxycycline in >80% of case. *P. mirabilis* was resistant to polymyxin B and doxycycline. All isolates of Klebsiella species, *E. coli,* and Citrobacter spp were resistant to ampiciliin. All *S. pneumoniae* strains were susceptible to penicillin. The ever increasing bacterial resistance to antimicrobial is alarming. Some of the reasons for the dramatic increase in resistance are inappropriate uses of antibiotics for viral upper respiratory tract infections, beta-lactamase productions by many strains of *S. aureus* and other bacteria.

In conclusion, Ear infections should be diagnosed and treated early by effective drugs before they cause hearing problems. Selection of the correct antibiotics for therapy against the infecting organisms is recommended after susceptibility tests. Thus, patients may benefit from the therapeutic intervention. This report provides relevant information on prevalence of ear infections among children for epidemiological purposes. This is essentially important to give clues for health strategy and control programs.

Further research is indicated to further determine the dominant patterns of virulence markers of the organisms.

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REFERENCES

1. O'Neil P. Acute otitis media: clinical evidence (clinical review). *BMJ.* 1999; **319**:833-835.
2. Moshi NH, Minja BM, Ole-Lengine L, Mwakagile DSM. Bacteriology of chronic otitis media in Dare Es salaam, Tanzania. *East Afr. Med. J.* 2000; **77**:20-2.
3. Bluestone CD. Otitis media and sinusitis: role of *Branhamella catarrhalis*. Drugs. 1986: **31** (Suppl. 3): 132-141.
4. Senturia BH, Bluestone CD, Klein JD. Definition and classification of the Ad Hoc Committee on the definition and classification of otitis media. *Ann Otorhinolaryngol.* 1980; **89**: 3-4.
5. Melaku A, Lulseged S. Chronic suppurative otitis media in a children's hospital in Addis Ababa, Ethiopia. *Ethiop Med J.* 1999; **37**: 237-246.
6. Ferede D, Geyid A, Lulseged S, Melaku A. Drug susceptibility pattern of bacterial isolates from children with chronic suppurative otitis media. *Ethiop J Health Dev.* 2001; **15**: 89-96.
7. Tessema G. Otitis media seen in Yekatit 12 Hospital. *Ethiop Med J.* 2001; **39**: 113- 121.

8. Duguid JP, Collee JG, Fraser AG. Laboratory strategy in the diagnosis of infective syndromes. In: Mackie and McCartey Practical Medical Microbiology. 13th ed. Collee JG, Duguid JP, Fraser AG and Marmion BP (eds.). Churchill Living Stone, London. Pp. 600-49, 1989.
9. Peter G. Streptococcal pharyngitis: current therapy and criteria for evaluation of new agents. *Clin. Infect. Dis.* 1992; **14** (Suppl. 2): S218-23.
10. Goldblat D, Turner MW, Levinsky RJ. *Branhamella catarrhalis*: Antigenic Determinants and the development of the IgG subclass response in child hood. *J. Infect. Dis.* 1990; **162:**1128-35.
11. Gebre-Selassie S. Isolation of *Moraxella catarrhalis* from the nasopharynx of out patients in a teaching Hospital. *Ethiop. J. Heath. Sci.* 1998; **8:** 1-4.
12. Del' Alamo L, Sampaio J, Miranda EA, Sader HS. Comparative in vitro Activities of Moxifloxacin (Bay. 12-8039) Other Antimicrobial Agents Against Respiratory Tract Pathogens in Brazil. *Braz J. Infect. Dis.* 1999; **3:** 215-19.
13. Paek KS, Kim MY, Lee CS, Youn H. In vitro and in vivo activities of LB10827, a new oral cephalosporin, against respiratory pathogens. *Antimicrob Agents Chemother.* 2000; **12:** 3272-77.
14. Commisso R, Romero-Orellano F, Montanaro PB, Romemro-Moroni F, Romero-Moroni F, Romero-Diaz R. Acute otitis media: Bacteriology and bacterial resistance in 20 paediatric patients. *Int. J. Pediatr. Otorhinolaryngol.* 2000; **56:**23-31.
15. Valdes JM, Baltch AL, Smith RP, Franke M, Riaz WJ, Wlliams S, et al. Comparative therapy with cefpirome alone and in combination with rifampicin and/or gentamicin against disseminated *Pseudomonas aeruginosa* infection in leukogenic mice. *J. Iinfect Dis.* 1990; **162:**1112-17.
16. Bauer AW, Kirby WMM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. *AM. J. Clin. Pathol.* 1966; **36**: 493-6.
17. National Committee for Clinical Laboratory Standards. Performance standards for antimicrobial disk susceptibility tests, 5th ed. Vol. 13, Villanova, Pa, 1993.
18. Teele D, Klein J, Rosner B, et al. Epidemiology of otitis media during the first seven years of life in children of greater Boston: a prospective cohort study. *J. Infect Dis.* 1989; **160**: 83-94.
19. Browning GG. Chronic suppurative otitis media: clinical review (commentary). *BMJ* 2002; **325**: 1159-1160 [Medline].