Egyptian Journal of Ear, Nose, Throat and Allied Sciences (2013) 14, 73–78

Egyptian Society of Ear, Nose, Throat and Allied Sciences

Egyptian Journal of Ear, Nose, Throat and Allied Sciences

www.ejentas.com

ORIGINAL ARTICLE

Bacterial otitis media in all age group of patients seen at Dessie referral hospital, North East Ethiopia

Abdurahaman Seid [a], Fetene Deribe [b], Kedir Ali [c], Gebre Kibru [b,*]

[a] *Department of Medical Laboratory Sciences, Wollega University, Ethiopia*
[b] *Department of Medical Laboratory Sciences and Pathology, Jimma University, Ethiopia*
[c] *Department of Internal Medicine, Dessie Referral Hospital, Ethiopia*

Received 21 January 2013; accepted 17 February 2013
Available online 20 March 2013

KEYWORDS
Otitis media;
Drug resistance;
Dessie referral hospital;
Ethiopia

Abstract *Background:* Otitis media is the main cause of deafness and hearing impairment and the most common reason for children to visit a medical practitioner.

Objective: Determination of bacterial etiology of otitis media and its susceptibility to drugs.

Methodology: A cross sectional study conducted on 191 otitis media patients seen in the Dessie referral hospital, November 2009–2010. Socio-demographic data were collected using a structured questionnaire. Pus from discharging ears was taken and processed for bacterial culture and susceptibility testing using standard bacteriological techniques.

Results: Participants age range was 3/12–70 years. Majority (83.2%) of them were identified as chronic otitis media. The frequency of otitis media below 15 years was 45.0%. Of 207 isolates, *Proteus* spp was the leading one, 48 (23.2%) followed by *Staphylococcus aureus* 44 (21.3%). *Escherichia coli, Enterobacter*, *Citrobacter*, and *Klebsiella* spp were 100% resistant to Amoxicillin. Almost all isolated bacteria became resistant to two or more antimicrobials.

Conclusion: Children aged less than 15 years were the most affected groups. *Proteus* spp, *S. aureus*, and *Pseudomonas* spp were the major isolated bacteria. Gentamycin and Ciprofloxacin were relatively effective antibiotics. However, all isolates showed multi drug resistance indicating the presence of strong selective pressures so that empirical treatment needs to be discouraged.

* Corresponding author. Address: P.O. Box 196, Jimma, Ethiopia. Tel.: +251 0471 12 01 49 (office), mobile: +2519 11 31 01 88; fax: +251 0471 11 44 88.
E-mail address: gebre.tiga@ju.edu.et (G. Kibru).

Peer review under responsibility of Egyptian Society of Ear, Nose, Throat and Allied Sciences.

ELSEVIER Production and hosting by Elsevier

1. Introduction

Otitis media (OM) is a general term used to describe any inflammatory process involving the middle ear cleft.[1–3] Clinically OM presents in several forms characterized by signs and symptoms, duration of the disease and type of exudates.[1,2] Acute otitis media (AOM) is inflammation of the middle ear with the production of otorrhea and other symptoms but with less than two weeks of duration whereas chronic otitis media

http://dx.doi.org/10.1016/j.ejenta.2013.02.005

(COM) holds perforation of the tympanic membrane and discharging for at least two weeks. In developing countries the natural course of the disease is different, leading to purulent otitis often with perforation and further complications[2] including recurrent acute otitis media, persistence of middle ear effusion which requires the insertion of drainage tube, hearing impairment, mastoiditis, meningitis, chronic otitis media, brain abscess and sepsis.[3] In adults, AOM is rare and is often associated with chronic upper airway infections. Patients with immune deficiency are also prone to OM especially those with HIV and patients with tumors in the naso-pharynx. In these patients, complication is more severe.[2]

OM is the most common reason for children less than five years of age to visit a medical practitioner and it is an important cause of preventable hearing loss, particularly in the developing world.[1–4] AOM is also one of the most common indications leading to antibiotic prescription in young children.[5] Many factors like genetic, infectious, immunologic and environmental conditions predispose individuals to ear infection.[1,6] Although the exact figure of cases and incidence rate is not yet known, OM and its complication is a common public health and economic problem all over the world particularly in developing countries.[2] Its chronic form is a significant and serious problem in all age groups with less probability of recovery.[7]

WHO estimates of the global number of people with disabling hearing impairment has increased substantially which rises from 42 million in 1985 to 250 million in the year 2001 with three quarters of these people having adult onset of hearing loss.[4] COM is a major global established infectious cause of deafness and hearing impairment[6] that accounts above 90% of all infectious causes and 18.8% of the burden of hearing loss to all consequences of infection. This burden of hearing loss due to COM occurs mainly in the developing world with the largest burden in the South East Asian region followed by Western Pacific and African regions of which COM accounts for 34.5%, 23.7% and 16.4% of the total burden of hearing loss respectively.[4] Besides chronic forms of otitis media, early onset OM (which occurs in infancy at the age of below one year old) largely associated with low socioeconomic status, allergy and large number of people in the household, is also a significant risk factor for the development of hearing loss.[8]

There are a few hospital-based studies documented in Ethiopia. A prospective study conducted in Addis Ababa showed that out of 2, 334 patients with ear problem 69.8% had otitis media of which the prevalence of COM with purulent discharge was 52.8% and that of AOM was 4.1%.[7] Other prospective study findings in the same city showed that chronic suppurative otitis media was 0.6% among the total hospital patient population and 22.3% in patients seen at the ear, nose and throat (ENT) clinic.[9] Moreover, a hospital based cross-sectional study conducted in the Jimma University specialized hospital indicated that out of 154 clinically suspected children (aged 2 months to 15 years), 40.3% and 59.7% had AOM and COM respectively. The prevalence of OM in children under two years old was highest (17.5%).[10] Thus, this study is thought to be complement in addressing the bacterial profile and their susceptibility pattern for commonly prescribed antimicrobials in the Northern regions of the country.

2. Materials and methods

2.1. Study design and participants

A cross-sectional hospital based study was conducted on 191 clinically diagnosed OM cases to determine bacteria etiologies and the antimicrobial susceptibility pattern of isolates from November 2009 to 2010 in the Dessie referral hospital. The hospital gives service for more than 7 million peoples living in North East Ethiopia with its different speciality.

Patients who were on antimicrobial drugs or had been taking antimicrobial drugs within two weeks prior to the sample collection day were excluded from the study. Clinical and demographic data were collected using a pre-structured questionnaire. The ear discharges were collected aseptically by an experienced laboratory technician using sterile swabs.[11] For these very few patients/children who came with an intact tympanic membrane, no attempt was made to aspirate fluid from behind the eardrum (Tympanocentesis) which usually requires an ENT specialist. Instead, ear swabs from such cases were taken immediately after the insertion of the sterile otoscopic cone as routine practice of clinical examination. Then, swabs were transported using Amie's transport media and inoculated within 2 h of collection on MacConkey agar, 5% defibrignated Blood agar, Chocolate agar and Manitol Salt agar plates (all from Himedia Company, India). The inoculated MacConkey agar and Manitol Salt agar plates were incubated in aerobic condition whereas Chocolate and Blood agar plates were kept in a candle jar, which can generate about 5% CO_2, at 35–37 °C for 18–24 h. Isolation of bacteria was made following standard microbiological methods.[12]

2.2. Drug susceptibility testing

Antimicrobial susceptibility testing was done using the modified Kirby-Bauer disc diffusion technique.[13] Gentamicin-CN (10 µg), Cephalothin-KF (30 µg), Amoxicillin-AML (10 µg), Ciprofloxacin-CIP (5 µg), Erythromycin-E (15 µg), Chloramphenicol-C (30 µg), Co-trimoxazole-Cotri (25 µg) (all from Oxoid, England), Penicillin G-P (10 iu) (Biodiscs), Oxacillin-OX (1 µg) (bioMerieux, France) and Tetracycline –T (30 µg) (Himedia, India) were selected based on WHO recommendations[14,2] and standard treatment guide lines of Ethiopia for the treatment of otitis media.[15]

Bacterial suspensions with turbidity standard equivalent to McFarland 0.5 were swabbed uniformly onto Mueller–Hinton agar plates (Himedia, India) using soaked sterile cotton swabs.[12] Then, incubated aerobically at 37 °C for 16–18 h except for Oxacillin (extended for 24 h).[13] Zone of inhibition diameters were interpreted as sensitive, intermediate and resistant according to the principles established by Clinical and Laboratory Standards institute (CLSI/NCCLS)[16] *E. coli* (ATCC25922), *S. aureus* (ATCC 25923) and *P .aeruginosa* (ATCC 27853) control strains were used to check the potency of antibiotic discs.

2.3. Data analysis

The data were entered into a computer and analyzed using SPSS version 16.0 software computer packages. Chi-square test was carried out to describe the association that could exist between measured variables. *P* value of less than 0.05 was considered to be statistically significant. The results were interpreted by their magnitude in terms of age, sex and other related variables of interest.

2.4. Ethical issues

This research was approved by the Jimma University ethical review board and a letter of permission was obtained from the management committee of the Dessie referral hospital. The culture and sensitivity results were reported to their respective physicians for any beneficiary measures.

3. Results

The age distribution of 191 clinically diagnosed otitis media (OM) patients was 3 months to 70 years giving the mean age of 18.8 years, median age of 16 years with standard deviation of 14.3. About 50.8% were males and 49.2% were females making a male to female ratio of 1.03:1.0. The majority (83.2%) of the patients were identified as chronic otitis media (COM) cases. The rate of acute otitis media (AOM) seems to be decreasing with advancing age (Table 1).

About 89.4% of ear swabs were culture positive. The rate of polymicrobial infection among chronic and acute OM cases was 27 (16.0%) and 8 (4.7%) respectively. However, these differences are not statistically significant ($P = 0.212$) (data not shown).

In this study, a total of 207 isolates were identified of which 78.7% were a group of gram negative bacteria. *Proteus* spp, *S. aureus* and *Pseudomonas* spp were the most common isolates in both acute and chronic OM accounting for 23.2%, 21.3%, and 14.5% respectively. However, no *Citrobacter* spp was isolated in AOM patients (Fig. 1).

Antimicrobial sensitivity tests indicated that all bacterial isolates were 0%–16.7% resistant to Gentamycin and Ciprofloxacin. Majority of the isolates showed a low rate of resistance to Chloramphenicol. However, *Enterobacter* spp, *E. coli*, *Citrobacter* spp and *Klebsiella* spp were 100% resistant to Amoxycillin and Oxacillin. Additionally, *Citrobacter* spp was 100% resistant to Cephalothin and Erythromycin. In general, all bacterial isolates showed 100% resistance to Penicillin (Table 2).

Antibiogram of isolates showed that 25.6% was resistant for the five and 22.2% resistant for the eight antimicrobial drugs tested. Nearly 43.3% of the *Pseudomonas* spp and 35.4% of the *Proteus* spp were resistant to eight antimicrobials. 30.8% of the *Providencia* spp, 30.0% of *E. coli* and 66.6% of the *Klebsiella* spp were resistant to five antimicrobial drugs. On average all the isolates were resistant for more than four tested antimicrobials (Table 3).

4. Discussion

Many studies indicate that OM is an important public health problem affecting all sex and age groups. It is the most frequent diseases for a child to visit a physician[3,4], and the most common indication for antibiotic prescribing.[5] In the same way, in this study 45.0% of OM patients were children less than 15 years old which is comparable to 34–46% reported elsewhere in the world.[17–20] Anatomical and immunological factors may account for such a high burden of OM in young children as it is indicated that the nasopharynx in young children is abundantly colonized with middle-ear pathogens and the short, broad and straight nature of the eustachian tube allows more ready access of bacteria into the middle ear. Additionally, the incidence of upper respiratory infections, which is important for subsequent middle ear bacterial infection, is high in young children because of immatured immunity.[2] Poorey VK and Lyer A also suggested that overcrowded living conditions, nutritional deficiencies, lack of hygiene and general poverty contribute for increased OM in children.[19]

In the present study the majority (83.2%) of OM cases were clinically diagnosed as COM which goes in agreement with the previous study findings in Ethiopia where rates of 59.7% [10] and 52.8%[7] were reported. Crowded living conditions, malnutrition and low socioeconomic status associated with poor hygiene could be reasons for the increased number of cases since these are identified as risk factors for the development of COM.[2,6] Moreover, as most of the isolates (*P. aeruginosa*, *E. coli* and *S. aureus*) in our study are biofilm forming organisms, that are known to be resistant to host defenses by creating an increased biomass which prevents them from phagocytosis and the formed extracellular polymeric substances (EPSs) which also provide a physical barrier to complement, antibody and immune cells.[21]

The main isolates in AOM in this study were *S. aureus* (4.3%), the *Proteus* spp (3.4%) and the *Pseudomonas* spp (3.4%) (Fig. 1). These findings agree with a study conducted in Nigeria where *S. aureus* and *Proteus mirabilis* were dominant isolates.[22] Our results are also comparable with Diriba et al. in Ethiopia where the *Proteus* spp and *S. aureus* were reported as major isolates of AOM.[10] However, it goes in contrary to a report from Cote D'Ivoire where *P. aeruginosa* and *S. pneumoniae were* found out to be leading isolates[23], in Brazil where *H. influenzae*, *S. pneumoniae* and *M. catarrhalis* were the dominant etiology of AOM[24] and a study in Israel that showed *S. pneumoniae* and *H. influenzae* were the dominant isolates.[25] Our findings support the concluding remark given by Tanon-Anoh et al. stating that *H. influenzae* and *M. catarrhalis* had no important role in the pathogenicity of AOM in the tropics.[23]

The overall rate of bacterial isolates for instance *Proteus* spp (23.2%), *S. aureus* (21.3%) and *Pseudomonas* spp (14.5%) both in acute and chronic OM in our study is comparable with previous reports in Ethiopia[9,10,26] and in Sudan.[27] Our results also agree with works of Arjyal et al.[28] and Mansoor et al.[18] that identified *S. aureus*, *P. aeruginosa* and *Proteus* spp as prevalent isolates among COM patients. However, the frequency of *Enterobacter* spp, *Citrobacter* spp, *Providencia* spp and *E. coli* were relatively high in the present study compared to previous reports elsewhere in Ethiopia.[9,10] This variation might be due to differences in the etiological distribution of OM in accordance to climatic conditions and cultural practices.[29]

In this study, the antimicrobial susceptibility patterns of isolates were completely variable. Gentamycin and ciprofloxacin were effective antibiotics against more than 90% of isolates. Similarly, chloramphenicol and co-trimoxazole were also effective for some of the isolates. Additionally, cephalothin and erythromycin were also effective against *S. aureus* but resistant to the rest of the isolates. In general, these

Table 1 Distribution of acute and chronic otitis media in relation to sex and, age of patients (n = 191) seen at the Dessie referral hospital, November 2009–2010, Dessie, North East Ethiopia.

	Type of otitis media			
		AOM (n = 32) No. (%)	COM (n = 159) No. (%)	Total No. (%)
Sex				
	Male	17(8.9)	80(41.9)	97(50.8)
	Female	15(7.9)	79(41.4)	94(49.2)
	Total	**32(16.8)**	**159(83.3)**	**191 (100)**
Age (years)				
	< 5	11(5.8)	22(11.5)	33(17.3)
	5–9	4(2.1)	14(7.3)	18(9.4)
	10–14	6(3.1)	29(15.2)	35(18.3)
	15–19	5(2.6)	27(14.1)	32(16.8)
	20–24	− (0.0)	20(10.5)	20(10.5)
	25–29	1(0.5)	16(8.4)	17(8.9)
	30–34	3(1.6)	4(2.1)	7(3.7)
	35–39	2(1.0)	8(4.2)	10(5.2)
	40–44	− (0.0)	6(3.1)	6(3.1)
	45–49	− (0.0)	4(2.1)	4(2.1)
	> = 50	− (0.0)	9(4.7)	9(4.7)
	Total	**32 (16.7)**	**159 (83.1)**	**191 (100)**

findings go in agreement with reports made in Ethiopia,[9,26] Singapore,[30] Iraq,[31] India,[32] Rawalpindi[33] and Nigeria.[34] Similarly, susceptibility of *S. aureus* to cephalothin in this study is in agreement with the work of Melaku and Lulseged where it was found out to be effective against gram-positive isolates in general.[9] Studies conducted in Ardebil,[35] Iraq,[31] Nepal,[28] India,[19] Rawalpindi[33] and Jordan[36] showed that ciprofloxacin was effective for for the treatment of OM, which goes in agreement with our work. On the other hand, gentamicin and ciprofloxacin resistant isolates were reported in Nigeria.[37] Jha et al.[17] indicating that gentamicin and ciprofloxacin are losing their effectiveness.

Multidrug resistance isolates in the present study were common and alarmingly high. Even some of the isolates were resistant for nearly all the antimicrobial drugs tested. This might reflect the degree of misuse of antibiotics, which is a worldwide problem mainly through their purchase without prescription in the local pharmacies and drug stores and through inappropriate prescribing habits and an over-zealous desire to treat every infection as it was mentioned by Ibeawuchi and Mabata.[38] This may result in treatment failure and disease complications. Additionally most of the bacteria isolated were known biofilm formers and bacterial biofilms are known to be 10–1000 times or more resistant to antibiotic treatment

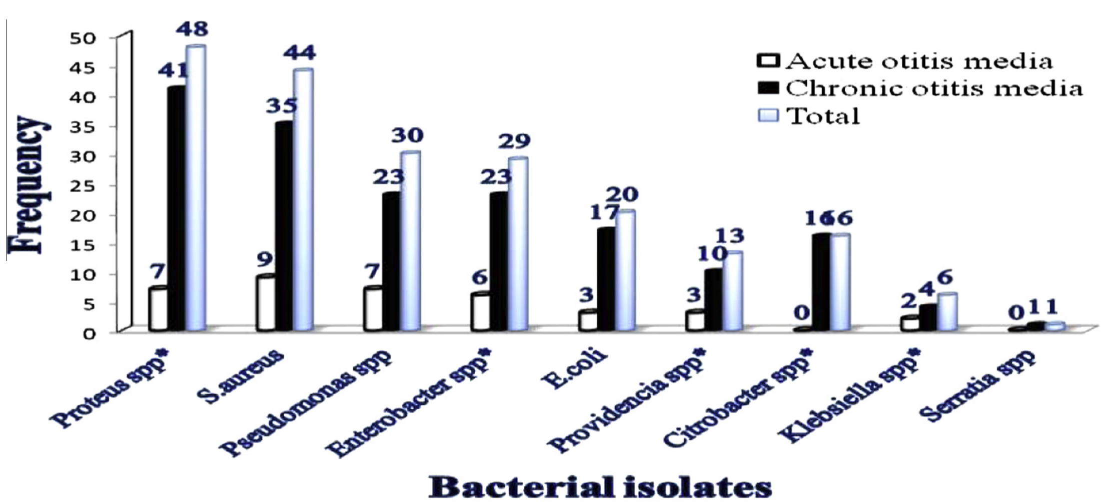

Figure 1 Bacterial isolates (n = 207) of otitis media at the Dessie referral hospital, November 2009–2010, Dessie, North East Ethiopia. * = *Enterobacter* spp: *Enterobacter cloacae*, *Enterobacter aerogenes*; *Citrobacter* spp: *Citrobacter koseri*, *Citrobacter freundii*; *Klebsiella* spp: *Klebsiella ozane*, *Klebsiella pneumonae*, *Klebsiella oxyteca*; *Providencia* spp: *Providencia rettgeri*, *Providencia stuartii*, *Providencia alcalificans*.

Table 2 Antimicrobial Resistance pattern of bacteria isolated from otitis media patients seen at the Dessie referral hospital from November 2009 to 2010, Dessie, North East Ethiopia.

Bacterial species (# of isolates)	Dugs resisted to no (%)									
	CN	KF	AML	CIP	T	E	P	C	OX	SXT
Proteus spp (48)	1 (2.1)	34 (70.8)	41 (85.5)	3 (6.3)	42 (87.5)	45 (93.8)	48 (100)	22 (45.8)	44 (91.7)	21 (43.8)
S. aureus (44)	3 (6.8)	11 (25)	36 (81.8)	1 (2.3)	23 (52.3)	14 (31.8)	40 (90.9)	6 (13.6)	28 (63.6)	14 (31.8)
Pseudomonas spp (30)	1 (3.3)	28 (93.3)	28 (93.3)	2 (6.7)	21 (70.0)	25 (83.3)	30 (100)	16 (53.3)	28 (93.3)	17 (56.7)
Enterobacter spp (29)	0 (0.0)	19 (65.5)	29 (100)	0 (0.0)	17 (58.8)	27 (93.1)	29 (100)	5 (17.2)	29 (100)	7 (24.1)
E. coli (20)	2 (10)	18 (90)	20 (100)	3 (15)	16 (80)	19 (95)	20 (100)	3 (15)	18 (90)	11 (55)
Providencia spp (13)	2 (15.4)	11 (84.6)	12 (92.3)	0 (0.0)	6 (46.2)	9 (69.2)	13 (100)	4 (30.8)	13 (100)	6 (46.2)
Citrobacter spp (16)	0 (0.0)	16 (100)	16 (100)	0 (0.0)	12 (75)	16 (100)	16 (100)	5 (30.8)	16 (100)	7 (46.2)
Klebsiella spp (6)	1 (16.7)	3 (50)	6 (100)	1 (16.7)	2 (33.3)	6 (100)	6 (100)	0 (0.0)	6 (100)	3 (50)
Serratia spp (1)	0 (0.0)	1 (100)	1 (100)	0 (0.0)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	0 (0.0)

CN: Gentamicin; KF: Cephalothin; AML: Amoxycillin; CIP: Ciprofloxacin; E: Erythromycin; P: Penicillin; C: Chloramphenicol; OX: Oxacillin; SXT: Co-trimoxazole; T: Tetracycline.

Table 3 Antibiogram of bacterial isolates from otitis media patients seen at the Dessie referral hospital from November 2009 to 2010, Dessie, North East Ethiopia.

Bacterial species (No)	Antibiogram pattern No. (%)							
	R2	R3	R4	R5	R6	R7	R8	R9
Proteus spp(48)	–	1(2.0)	6(12.5)	12(25.0)	8(16.7)	3(6.3)	17(35.4)	1(2.0)
S. aureus (44)	6(13.6)	14(31.)	6(13.6)	11(25.0)	4(9.1)	2(4.5)	1(2.3)	–
Pseudomonas spp (30)	1(3.3)	1(3.3)	2(6.7)	6(20.0)	2(6.7)	4(13.3)	13(43.3)	1(3.3)
Enterobacter spp (29)	–	–	9(31.0)	6(20.7)	7(24.1)	3(10.3)	4(13.8)	–
E. coli (20)	–	–	2(10.0)	6(30.0)	4(20.0)	3(15.0)	5(25.0)	2(10.)
Providencia spp (13)	1(7.7)	–	1(7.7)	4(30.8)	2(15.4)	1(7.7)	1(7.7)	2(15.)
Citrobacter spp (16)	–	–	–	4(25.0)	4(25.0)	4(25.0)	4(25.0)	–
Klebsiella spp (6)	–	–	–	4(66.6)	1(16.7)	–	1(16.7)	–
Total (207)	8(3.9)	16(7.7)	26(12.6)	53(25.6)	32(15.5)	20(9.7)	46(22.2)	6(2.9)

R2–R9 = resistance to 2, 3, 4, 5, 6, 7, 8, or 9 antimicrobials in that order.

when compared with genetically identical planktonic bacteria.[21] This might contribute for increased multidrug resistance observed in this study. Unavailability of culture facilities and empirical prescription of these antimicrobial drugs in the study setting might also be the important contributing factor for the development of multidrug resistance among these isolates.

5. Conclusions

As shown in this study the *Proteus* spp, *S. aureus*, the *Pseudomonas* spp and the *Enterobacter* spp were dominant etiological agents of OM in Dessie and its surroundings. Most of the isolates were susceptible to Gentamycin and Ciprofloxacin and to a lesser extent to Chloramphenicol. Cephalothin and Erythromycin were the only effective drugs against *S. aureus*. However, our work has recorded a high resistance rate of bacterial isolates to the commonly used antibiotics like Amoxicillin, Tetracycline, Erythromycin, Penicillin, Oxacillin and Cephalothin. This increasing bacterial resistance rate to antimicrobials is alarming and indicates the presence of strong selective pressures from the antibiotics in the community. These emphasize the need for culture and antimicrobial sensitivity testing facilities in place in order to minimize empirical treatment of both acute and chronic OM. Moreover, it is advisable doing antimicrobial susceptibility testing periodically to follow the changes of patterns of etiological agents and sensitivity rate over time.

Acknowledgements

Authors would like to acknowledge the Jimma University for funding and the Dessie Regional Health and Research Laboratory for providing us some culture media, reagents and antimicrobial discs.

References

1. Cripps AW, Kyd J. Bacterial otitis media: current vaccine development strategies. *Immunol Cell Biol*. 2003;81:46–51.
2. Gröte JJ, Vallely PJ. Otitis media. In: Newton VE, Valley PJ, eds. *Infection and Hearing Impairment*. England: John Wiley & Sons Ltd; 2006:71–181.
3. Winn W, Allen S, Janda W, et al. *Koneman's Color Atlas and Textbook of Diagnostic Microbiology*. 6th ed. Philadelphia USA: Lippincott's Williams and Wilkins; 2006, p. 439–440 and 211–302.
4. Smith A, Mathers C. Epidemiology of infection as a cause of hearing impairment. In: Newton VE, Vallely PJ, eds. *Infection and hearing impairment*. England: John Wiley & Sons Ltd; 2006:31–36.
5. Grevers G. Challenges in reducing the burden of otitis media disease: an ENT perspective on improving management and prospects for prevention. *Int J Pediatr Otorhinolaryngol*. 2010;74: 572–577.
6. Prevention of hearing impairment from chronic otitis media. WHO/ CIBA foundation work shop report, London, UK, 1996; 19–21.
7. Tessema G. Otitis media seen in Yekatit 12 hospital. *Ethiop Med J*. 2001;39:113–121.
8. Lasisi AO, Olayemi O, Irabor AE. Early onset otitis media: risk factors and effects on the outcome of chronic suppurative otitis media. *Eur Arch Otorhinolaryngol*. 2008;265:765–768.
9. Melaku A, Lulseged S. Chronic suppurative otitis media in children's hospital in Addis Ababa. *Ethiopia Ethiop Med J*. 1999;37:237–246.
10. Diriba M, Solomon G, Hailu N. Isolation and antimicrobial susceptibility pattern of bacterial pathogens causing otitis media in children in Jimma hospital, South Western Ethiopia. *Ethiop J Health Sci*. 2004;14(2):89–100.
11. Adoga AS, Maàn EN, Malu D, Badung BP, Obiesie IV, Nwaorgu OGB. Swab and aspiration specimen collection methods and antibiogram in chronic suppurative otitis media at Jos University teaching hospital: which is superior? *Ann Afr Med*. 2010;9(4): 230–234.
12. Cheesbrough M. *District laboratory practice in tropical countries part II*. 2nd ed. NewYork: Cambridge university press; 2006.
13. Bauer AW, Kirby WM, Sherris JD, Turch M. Antibiotic susceptibility testing by standard single disk method. *Am J Clin Path*. 1966;45:493–496.
14. World Health Organization. *Technical updates of the guidelines on the integrated management of childhood illness (IMCI): evidence and recommendations for further adaptations*. Geneva: WHO; 2005.
15. Drug administration and control authority of Ethiopia. Standard treatment guidelines for general hospital. 2nd ed. 2010.
16. Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing. Fifteenth information supplement. CLSI/NCCLS document M100–S15. 2005; 25(1).
17. Jha AK, Singh JB, Dutta D. Microorganisms present in discharging otitis media in a group of patients in Kathmandu. *Nepal Med Coll J*. 2007;9(3):196–198.
18. Mansoor T, Musani MA, Khalid G, Kamal M. *Pseudomonas aeruginosa* in chronic suppur ative otitis media: sensitivity spectrum against various antibiotics in Karachi. *J Ayub Med Coll Abbottabad*. 2009;21(2):120–123.
19. Poorey Vk, Lyer A. Study of bacterial flora in chronic suppurative otitis media and its clinical significance. *Indian. J Otolaryngol Head Neck Surg*. 2002;54(2):91–95.
20. Abusi CN, Ologe FE. Pathogenic agent of chronic suppurative otitis media Ilorin. *Nigeria East Afr Med J*. 2002;79(4):202–205.
21. Christopher Post J, Luisa Hiller N, Nistico L, Stoodley P, Ehrlicha GD. The role of biofilms in otolaryngologic infections: update. *Curr Opin Otolaryngol Head Neck Surg*. 2007;15:347–351.
22. Ako-Nai AK, Oluga FA, Onipede AO, Adejuyigbe EA, Amusa YB. The characterization of bacterial isolates from acute otitis media in Ile-Ife. *South-Western Nigeria J Trop Pediatr*. 2002;48(1):15–23.
23. Tanon-Anoh MJ, Kacou-Ndouba A, Yoda M, Ette-Akre E, Sanogo D, Kouassi B. Particularities of bacterial ecology of acute otitis media in an African subtropical country (Cote D'Ivoire). *Int J Pediatr Otorhinolaryngol*. 2006;70:817–822.
24. Pereira MB, Pereira M R, Cantarelli V, Costa SS. Prevalence of bacteria in children with otitis media with effusion. *J Pediatr (Rio J)*. 2004;80(1):41–48.
25. Sakran W, Makary H, Colodner R, et al. Acute otitis media in infants less than three months of age: clinical presentation, etiology and concomitant diseases. *Int J Pediatr Otorhinolaryngol*. 2006;70:613–617.
26. 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(2):89–96.
27. Yagi HI. Chronic suppurative otitis media in Sudanese patients. *East Afric Med J*. 1990;67(1):4–8.
28. Arjyal C, Adhikari S, Shrestha J. Bacteriological study of ear discharge in bir hospital. *J Nepal Med Assoc*. 2002;41:318–322.
29. Yildirim A, Erdem H, Kilic S, Yetiser S, Pahsa A. Effect of climate on the bacteriology of chronic suppurative otitis media. *Ann Otol Rhinol Laryngol*. 2005;114(8):652–655.
30. Loy AH, Tan AL, Lu PKS. Microbiology of chronic suppurative otitis media. *Singapore Med J*. 2002;43(6):296–299.
31. Alsaimary IE, Alabbasi AM, Najim JM. Antibiotics susceptibility of bacterial pathogens associated with otitis media. *J Bacteriol Res*. 2010;2(4):41–50.
32. Maji PK, Chatterjee TK, Chatterjee S, Chakrabarty J, Mukhopadhyay BB. The investigation of bacteriology of chronic suppurative otitis media in patients attending a tertiary care hospital with special emphasis on seasonal variation. *Indian J Otolaryngol Head Neck Surg*. 2007;59:128–131.
33. Alam GA, Rahim E, Ali L, Ahmed S. Chronic suppurative otitis media: frequency of *Pseudomonas aeruginosa* in patients and its sensitivity to various antibiotics. *Prof Med J*. 2007;14(3): 411–415.
34. Wariso BA, Ibe SN. Bacteriology of chronic discharging ears in port Harcourt. *Nigeria West Afr J Med*. 2006;25(4):219–222.
35. Ettehad GH, Refahi S, Nennati A, Pirzadeh A, Daryani A. Microbial and antimicrobial susceptibility pattern from patients with chronic otitis media in Ardebil. *Int J Trop Med*. 2006;1(2): 62–65.
36. Mohammad A. Etiology and antimicrobial susceptibility pattern of otitis media in children at princess Rhamah hospital in Jordan. *The N Iraqi J Med*. 2010;6(1):27–30.
37. Egbe C, Mordi R, Omoregie R, Enabulele O. Prevalence of otitis media in Okada community, Edo State, Nigeria. *Maced J Med Sci*. 2010;1–4.
38. Perencevich EN, McGregor JC, Shardell M, et al. Summer peaks in the incidences of gram-negative bacterial infection among hospitalized patients. *Infect Control Hosp Epidemiol*. 2008;29: 1124–1131.