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RESEARCH ARTICLE OPEN ACCESS

Prevalence and Antibiotic Sensitivity Profile of Bacteria in Patients with Ear Infections

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Abstract

Ear infections are extremely common and widespread otological disorders in children and adults. Accordingly, it is critical to identify the etiological factors and determine their antimicrobial susceptibility to achieve successful clinical outcomes. Ear swab samples were collected from patients aged 10-69 years at the Al-Sadar Teaching Hospital in Al-Amara city and cultured using the standard microbiological methods. The VITEK 2-compact system was used to analyze the bacterial isolates. A total of 100 samples were obtained; ear infection was slightly elevated in men (58%), but this was not significant. A significantly higher incidence of ear infection was observed in the patients aged 10-19 years (P≤ 0.05). Of the 100 examined ear swab samples, 76 yielded positive culture results, and of these, 61 were axenic and 15 were mixed. Among the 91 retrieved bacterial isolates, *Pseudomonas aeruginosa* (24/91, 26.3%) and *Staphylococcus aureus* (21/91, 23%) were the common causative agents of ear infection, while Haemophilus influenzae (2/91, 2.19%) and *Staphylococcus hominis* (1/91, 1.09%) were less common. Most bacterial isolates showed high sensitivity to imipenem and amikacin (87.9% and 79.1%, respectively; P≤ 0.01), followed by ciprofloxacin and gentamicin (67% and 60.4%, respectively; P≤ 0.05), and low sensitivity to amoxicillin/clavulanic acid and ampicillin (15.3% and 6.6%, respectively). Multidrug resistance was observed in most of the isolates.

Keywords: Ear Infection, Bacteria, Antibiotics, Al-Amara, Iraq

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INTRODUCTION

Ear infection results in ear inflammation, with ear discharge being one of the most prevalent signs.[1] Globally, ear infections affect approximately 330 million individuals; of these, 60% have substantial hearing loss.[2] Ear infections may be acute or chronic purulent,[3] occurring in the external, middle, or internal parts of the ear.[4] Inflammation of the middle ear, known as otitis media, is a common type of ear infection.[5] As the eustachian canal is shorter and more horizontal in children than that in adults, children have a higher frequency of ear infections than adults.[6]

Although the etiologies vary based on the geographical areas,[7,8] *Streptococcus pneumoniae, Staphylococcus aureus,* and *Haemophilus influenza* are more commonly isolated from acute ear infections,[9] whereas *Pseudomonas aeruginosa, S. aureus, Proteus mirabilis, Klebsiella pneumonia,* and *Escherichia coli* are more common in chronic infections.[5] The development and spread of bacterial resistance have become a serious concern for global health owing to the increasing and irrational use of broad-spectrum antibiotics.[3,10] Complications, such as meningitis and brain abscess, may arise as a result of the increased prevalence of antibiotic-resistant bacteria in ear infections.[7] Additionally, middle ear tumors, post-aural edema, and aural sinuses can result from ear infections.[8]

Recently, ear infections have been reported in both sexes and different age groups in Al-Amara city, Maysan, Iraq. This study was aimed at identifying the bacterial species associated with the reported cases of ear infections and determining their sensitivity to antibiotics.

Patients and Methods

Study design and Ethical approval

This descriptive study was conducted between February and May 2022 at the College of Pharmacy, University of Misan, Al-Amara City, Misan Governorate, Iraq. The study was approved by the ethics committee of the College of Pharmacy, University of Misan, and written informed consent was obtained from all the volunteers or their parents for the collection of their data for this study. Data about the age and sex of the participants were collected using questionnaires.

Sample collection and participants

One hundred ear swab samples were collected from patients aged 10-69 years who visited the ear, nose, and throat clinic at the Al-Sader Teaching Hospital in Al-Amara, Iraq. Ear discharge samples were collected using sterile cotton swabs (Hemidia, Netherlands), placed in Amies transport media (Hemidia, Netherlands), and transported to the microbiology laboratory of the College of Pharmacy within 1 h.

Isolation and identification of bacteria

Samples plated onto blood and MacConkey agar plates (Oxoid, UK) were cultured aerobically, whereas those plated onto chocolate agar were incubated in a candle jar at 37°C for 24 hours.[11] Bacterial colonies were initially identified based on Gram staining, colony morphology, and hemolysis type. Final identification was performed using the Vitek 2 system (Gram Negative, Gram Positive, and Neisseria-Haemophilus identification cards (GP, GN, and NH ID cards, Biomereiux, France)).

Antibiotic sensitivity testing

The standard disk diffusion method was used to test the antibiotic sensitivity, and the results were interpreted in accordance to the Clinical Laboratory Standard Institute guidelines.[12] The tested antibiotics were ampicillin (10 µg), amikacin (30 µg), amoxicillin/clavulanic acid (30 µg), ceftazidine (30 µg), ceftriaxone (30 µg), co-trimaxazole (25 µg), ciprofloxacin (5 µg), gentamicin (10 µg), imipenem (30 µg), and tetracycline (30 µg) (Titan, Biotech., India).

Statistical analysis

Data were analyzed using the chi-square test in the Statistical Package for Social Science Software version 19. *P-value* ≤ 0.05 was considered significant.

RESULTS

A significant difference was observed in the incidence of ear infections between

Table 1. Sex and age distribution among patients with ear infection

Sex	Percentage	Age group (years)	Percentage
Males	58%	10-19	61%*
		20-29	19%
		30-39	12%
Female	42%	40-49	4%
		50-59	2%
		60-69	2%
Total	100%	Total	100%

*: P ≤ 0.05

the patients aged 10-19 years (61%; P ≤ 0.05) compared to those aged 20 or more than years old, with no significant difference between the men and women (58% and 42%, respectively; Table 1). A total of 100 ear swab samples were tested; bacterial growth was observed in 76 samples only compared to 24 with no growth (*P* ≤ 0.01). Only 61 samples yielded axenic, not mixed, cultures (*P* ≤ 0.05; Table 2). Among the 91 bacterial isolates, *P. aeruginosa* and *S. aureus* were the most commonly observed bacterial strains (24 and 21, respectively), followed by *P. mirabilis, Staphylococcus epidermidis, K. pneumonia, E. coli, S. pneumonia, Proteus vulgaris, H. influenza,* and *Staphylococcus hominis* (13, 10, 7, 5, 4, 4, 2, and 1 case(s), respectively).

Antibiotic sensitivity testing for bacterial ear infections (n=91) showed high sensitivity to imipenem and amikacin (87.9% and 79.1%, respectively; P ≤ 0.01), followed by ciprofloxacin and gentamicin (67% and 60.4%, respectively; P ≤ 0.05), and low sensitivity to amoxicillin/clavulanic acid and ampicillin (16.4% and 6.6%, respectively; Table 3).

DISCUSSION

The present study indicated that patients aged 10-19 years had the highest incidence of ear infections, which is consistent with previous studies which reported that most ear infections occurred in people less than 20 years old.[13-16] The short, broad, and straight structure of the eustachian tube, in addition to poor hygiene, a weakened immune system, frequent exposure to upper respiratory tract infections, and malnutrition

Table 2. Bacterial culture isolated from ear swab samples

Bacterial culture		Number	
Growth	Axenic	61*	76
	Mixed	15	
No growth			24
Total samples			100

*: P ≤ 0.05

may all contribute to the higher prevalence of ear infections in children compared to that observed in adults.[3,8,17] Furthermore, ear infections were slightly more common in men than women (58% vs 42%, respectively), but no significant difference was observed, which agrees with the findings of previous studies.[14,18,19]

In this study, most of the examined samples (61%) showed axenic cultures, which is consistent with the findings of previous reports.[14,20,21] Furthermore, the predominant causative agents were *P. aeruginosa*, followed by *S. aureus*, which is also consistent with some previous studies.[21-25] However, other studies have reported that *S. aureus* was the most prevalent pathogen.[3,26,27] Recently, Udden et al.[28] revealed that Proteus spp. are common pathogens that caused ear infections. The distribution of pathogenic bacteria may differ according to the geographical region and climate variations. *P. aeruginosa* and *S. aureus* were the most frequently isolated pathogens in our study, which could be attributed to their ability to form biofilms, compete with other microorganisms for resources, or resist antibiotics. Additionally, *P. aeruginosa* attaches to the middle ear epithelium, which is necrotic or damaged by the pili. Upon attachment, the microorganism produces enzymes, such as proteases, to bypass the natural defenses of the body against infections.[29]

In the present study, there were variations in the antibiotic susceptibility patterns of the bacterial isolates. Imipenem and amikacin were the most effective antibiotics against most isolates, followed by ciprofloxacin and gentamicin. Our findings go in line with the results of a study by Al-Ramadi.[21] On the other hand, the majority of the isolates were highly resistant to ampicillin and amoxicillin/clavulanic acid, which is consistent with

Table 3. Antibiotic susceptibility profile of bacterial isolates from patients with ear infection

Bacterial isolates	*N	Sensitivity pattern of antibiotics n(%)									
		IMP	AK	CIP	CN	TE	CTR	CAZ	SXT	AMC	AMP
P. aeruginosa	24	19(79.1)	18(75)	13(54.1)	10(41.6)	8(33.3)	5(20.8)	5(20.8)	2(8.3	0(0)	0(0)
S. aureus	21	21(100)	18(85.7)	17(80.9)	12(57.1)	11(52.3)	10(47.6)	10(47.6)	4(19)	6(28.5)	0(0)
P. mirabilis	13	10(76.9)	10(76.9)	8(61.5)	7(53.8)	6(46.1)	4(30.7)	3(23)	4(30.7)	1(7.6)	0(0)
S. epidermidis	10	10(100)	9(90)	8(80)	9(90)	7(70)	7(70)	6(60)	3(30)	2(20)	2(20)
K. pneumonia	7	5(71.4)	5(71.4)	3(42.8)	3(42.8)	2(28.5)	2(28.5)	1(14.2)	2(28.5)	0(0)	0(0)
E. coli	5	3(60)	3(60)	3(60)	4(80)	2(40)	2(40)	1(20)	2(40)	0(0)	0(0)
S. pneumoniae	4	4(100)	4(100)	4(100)	4(100)	4(100)	4(100)	4(100)	3(75)	2(50)	3(75)
P. vulgaris	4	3(75)	2(50)	2(50)	3(75)	3(75)	3(75)	3(75)	1(25)	0(0)	0(0)
H. influenzae	2	2(100)	2(100)	2(100)	2(100)	2(100)	2(100)	2(100)	1(50)	1(50)	1(50)
S. hominis	1	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)	1(100)	0(0)
Total	91	80 (87.9)**	72 (79.1)**	61 (67)***	55 (60.4)***	47 (51.6)	41 (45)	37 (40.6)	23 (25.3)	14 (15.3)	6 (6.6)

*N: Number of isolates, **: P ≤ 0.01, ***: P ≤ 0.05
IMP: Imipenem, AK: Amikacin, CN: Gentamicin, CIP: Ciprofloxacin, TE: Tetracycline, CTR: Ceftriaxone, CFX: Ceftazidine, SXT: Co-trimaxazole, AMC: Amoxicillin/clavulanic acid, AMP: Ampicillin

the findings of previous studies.[7,8,25,29] The high rates of resistance to ampicillin and amoxicillin/clavulanic acid observed in this study may be attributed to improper use of antibiotics and self-prescription by the patients.

CONCLUSION

The incidence of ear infections was higher in the age group under 20 years among the patients in Al-Amara city. *P. aeruginosa* and *S. aureus* were identified as the predominant causative agents of ear infections. Despite the high rate of multiple drug resistance among the bacterial isolates, imipenem and amikacin were very effective against most of the isolates.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

FUNDING

None.

DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

The study was approved by the Ethical Committee of the College of Pharmacy, University of Misan, Maysan, Iraq, with reference number EA313.

INFORMED CONSENT

Written informed consent was obtained from the participants before enrolling in the study.

REFERENCES

1. De A, Varaiya A, Tainwala S, Mathur M. Bacteriology of acute otitis media in children. *Indian J Med Microbiol.* 2002;20(1):54-55.
2. Woodfield G, Dugdale A. Evidence behind the WHO guidelines: hospital care for children: what is the most effective antibiotic regime for chronic suppurative otitis media in children? *J Trop Pediatr.* 2008;54(3):151-156. doi: 10.1093/tropej/fmn042
3. Wasihun AG, Zemene Y. Bacterial profile and antimicrobial susceptibility patterns of otitis media in Ayder Teaching and Referral Hospital, Mekelle University, Northern Ethiopia. *SpringerPlus.* 2015;4(1):701. doi: 10.1186/s40064-015-1471-z
4. Berman S. Otitis media in children. *N Engl*

J Med. 1995;332(23):1560-1565. doi: 10.1056/NEJM199506083322307
5. Afolabi OA, Salaudeen AG, Ologe FE, Nwabuisi C, Nwawolo CC. Pattern of bacterial isolates in the middle ear discharge of patients with chronic suppurative otitis media in a tertiary hospital in North central Nigeria. *Afr Health Sci.* 2012;12(3):362-367. doi: 10.4314/ahs.v12i3.18
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(2). doi: 10.4314/ejhd.v15i2.9882
7. Abera B, Kibret M. Bacteriology and antimicrobial susceptibility of otitis media at dessie regional health research laboratory, Ethiopia. *Ethiop J Health Dev.* 2011;25(2):161-167. doi: 10.4314/EJHD.V25I2
8. Ahmad S. Antibiotics in chronic suppurative otitis media: A bacteriologic study. *Egyptian Journal of Ear, Nose, Throat and Allied Sciences.* 2013;14(3):191-194. doi: 10.1016/j.ejenta.2013.06.001
9. Brook I, Frazier EH. Microbial dynamics of persistent purulent otitis media in children. *J Pediatr.* 1996;128(2):237-240. doi: 10.1016/S0022-3476(96)70397-9
10. Agrawal A, Kumar D, Goyal A, Goyal S, Singh N, Khandelwal G. Microbiological profile and their antimicrobial sensitivity pattern in patients of otitis media with ear discharge. *Indian J Otol.* 2013;19(1):5-8. doi: 10.4103/0971-7749.108149
11. Cheesbrough M. District laboratory practice in tropical countries, part II. Cambridge university press. 2006. doi: 10.1017/CBO9780511543470
12. Wayne PA. Clinical and laboratory standards institute. Performance standards for antimicrobial susceptibility testing . 2014.
13. Shyamala R, Reddy PS. The study of bacteriological agents of chronic suppurative otitis media-aerobic culture and evaluation. *J Microbiol Biotechnol Res.* 2012;2:152-162.
14. Hailu D, Mekonnen D, Derbie A, Mulu W, Abera B. Pathogenic bacteria profile and antimicrobial susceptibility patterns of ear infection at Bahir Dar Regional Health Research Laboratory Center, Ethiopia. *SpringerPlus.* 2016;5(1):1-6. doi: 10.1186/s40064-016-2123-7
15. Abraham ZS, Ntunaguzi D, Kahinga AA, et al. Prevalence and etiological agents for chronic suppurative otitis media in a tertiary hospital in Tanzania. *BMC Res Notes.* 2019;12(1):429. doi: 10.1186/s13104-019-4483-x
16. Juma AS, Ubeid MH. A Microbiological Survey of Ear Infections in Inhabitants of Erbil City. *Cihan University-Erbil Scientific Journal.* 2022;6(2):62-67. doi: 10.24086/cuesj. v6n2y2022.pp62-67
17. Muluye D, Wondimeneh Y, Ferede G, Moges F, Nega T. Bacterial isolates and drug susceptibility patterns of ear discharge from patients with ear infection at Gondar University Hospital, Northwest Ethiopia. *BMC Ear, Nose and Throat Disorders.* 2013;13(1):1-5. doi: 10.1186/1472-6815-13-10
18. Aldhaher ZA, Hassan HF, Al-Jassim ZG, Mahmood MA. Bacterial isolates and antibiotic susceptibility of ear infections in Iraqi patients. *International Journal of Biosciences.* 2018;13(1):292-297. doi: 10.12692/ijb/13.1.292-297
19. Gorems K, Beyene G, Berhane M, Mekonnen Z. Antimicrobial susceptibility patterns of bacteria isolated from patients with ear discharge in Jimma Town, Southwest, Ethiopia. *BMC Ear, Nose and Throat Disorders.* 2018;18(1):1-9. doi: 10.1186/s12901-018-0065-0
20. Nazir A, Kadri SM. Aerobic bacteriology of chronic suppurative otitis media: a hospital based study. *Int J Res Med Sci*. 2014;(4):1521-1525. doi: 10.5455/2320-6012.ijrms20141152
21. Al-Ani RM, Al-Zubaidi MI, Lafi SA. Profile of aerobic bacteria and their antibiotic sensitivity in chronic suppurative otitis media in Al-Ramadi Teaching Hospital, Ramadi City, Iraq. *Qatar Med J.* 2021;2021(1):3. doi: 10.5339/qmj.2021.3
22. Hassooni HR, Fadhil SF, Hameed RM, Alhusseiny AH, Jadoo SAA. Upper respiratory tract infection and otitis media are clinically and microbiologically associated. *Journal of Ideas in Health*. 2018;1(1):29-33. doi: 10.47108/jidhealth.Vol1.Iss1.7
23. Al-Mosawi RM. Microbiological study and antimicrobial susceptibility pattern of ear infections in patients with Chronic Suppurative Otitis Media (CSOM) in Basrah Province. *University of Thi-Qar Journal of Science.* 2018;2(4):109-116. https://jsci.utq.edu.iq/ index.php/main/article/view/75
24. Javed M, Arshad M, Khan MA. Pathogenic bacteria profile and antimicrobial susceptibility patterns of ear infection at Ayub Medical Complex Abbottabad, Pakistan. *Pure Appl Biol.* 2020;9(1):714-719. doi: 10.19045/bspab.2020.90077
25. Agha ZHM, Al-Delaimi MS. Prevalence of common bacterial etiology and antimicrobial susceptibility pattern in patients with otitis media in Duhok Province-Iraq. *Zanco Journal of Pure and Applied Sciences.* 2021;33(4):11-25. doi: 10.21271/ZJPAS.33.4.2
26. Mittal R, Lisi CV, Gerring R, et al. Current concepts in the pathogenesis and treatment of chronic suppurative otitis media. *J Med Microbiol.* 2015;64(10):1103-1116. doi: 10.1099/jmm.0.000155
27. Hateet RR, Banoon SR, Mohammed MM. Isolation and Identification of Pathogenic Bacteria Causing Otitis Media in Misan Governorate. *J Pure Appl Microbiol.* 2022;16(2):1384-1391. doi: 10.22207/JPAM.16.2.66
28. Udden F, Filipe M, Reimer A, Paul M, Matuschek E, Thegerstrom J. Aerobic bacteria associated with chronic suppurative otitis media in Angola. *Infect Dis Poverty.* 2018;7(1):42. doi: 10.1186/s40249-018-0422-7
29. Seid A, Deribe F, Ali K, Kibru G. Bacterial otitis media in all age group of patients seen at Dessie referral hospital, North East Ethiopia. *Egyptian Journal of Ear, Nose, Throat and Allied Sciences.* 2013;14(2):73-78. doi: 10.1016/j.ejenta.2013.02.005