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Bacterial isolates and drug susceptibility patterns of ear discharge from patients with ear infection at National Ear Care Centre, Kaduna North Central, NigeriaBello, M.^{1*} and Danraka, B.R.²

Department of Medical Microbiology, Faculty of Medical Laboratory Science, Usmanu Danfodiyo University, P.M.B. 2346, Sokoto, Nigeria¹, Research and Technical Services, National Water Resources Institute, Kaduna, Nigeria².

Author for Correspondence: bmukhtar18@yahoo.com/+234-360-560-004

Abstract

Discharging ear(s) has a worldwide prevalence and is more common in children. The aetiologies and antibiogram varies with age, time and geographical location. Discharging ear(s) is most commonly caused by damage to any of the sensitive part of the ear which may or may not lead to infection depending on the patient's medical history, exposure, age, nutrition, environment and socio-economic status. This study aimed to isolate and characterize the causative agents of ear infection and their susceptibility patterns among patients attending National Ear Care Centre, Kaduna. A total of one hundred and one (101) samples from patients of all age range, both outpatients and those on admission presenting with signs and symptoms of Otitis media were taken. The samples were cultured and isolates identified using standard microbiological techniques. Antibiotic susceptibility tests were performed on bacterial isolates using the Stoke's disc (disc diffusion method). Out of the one hundred and one samples collected from the patients with discharging ears, 77.23% incidence rate was recorded; 37.6% were children of 5 years and below, with 52.48% having unilateral ear discharge. *Pseudomonas* species (35.6%) were the most prevalent bacterial isolate followed by *Staphylococcus aureus* (31.4%). *Staphylococcus epidermidis* (6%), *Streptococcus* species (6%), *Candida* species (6%), *E. coli* (5%), *Klebsiella* species (5%), *Proteus* species (4%) and *Haemophilis* species (1%) were other organisms isolated. Ciprofloxacin exhibited best activity against the bacterial isolates (82.08%) followed by Gentamicin (73.58%), while Cotrimoxazole,

Chloramphenicol and *Cefuroxime* were ineffective against the bacterial isolates. Evaluation of microbiological patterns and their antibiotic sensitivity is of great importance in prescribing empirical antibiotics for successful treatment of Otitis media and thus minimizing its complications and emergence of resistant strains.

Key words: Ear Infection, Bacterial isolates, Drug susceptibility patterns, National Ear Care Centre, Kaduna, North Central, Nigeria.

Introduction

Ear infection often termed "Otitis" occurs when a bacterial or viral infection affects the middle ear; the sections of the ear just behind the eardrum. Ear infections can be painful because of inflammation and fluid buildup in the middle ear (Woodfield and Dugdale, 2008). The infection may manifest as an inflammation or discharge as a result of the presence of bacteria or fungi or in some rare cases virus in the ear (Woodfield and Dugdale, 2008). The ear provides an optimal environment for the organisms to colonize and grow because it is moist, dark and warm (Muluye *et al.*, 2013).

The etiologies and prevalence of ear infection is different in different geographical areas (Muluye *et al.*, 2013), and according to World Health Organization survey, countries can be clustered into those having low ear infection when a prevalence rate of ear infection among children is between 1-2% and high when it is 3-6% (WHO, 2004).

Discharging ear can either be due to ear infection or trauma to any part of the ear both internal and external. Patients with ear discharge account for 12.4% of visits to the office-based pediatricians and 1.7% of visits to general practitioners (Froom *et al.*, 1990, 1995).

There are different types of ear discharge that can often be identified by the color, viscosity (fluid thickness) and odor. Broadly, ear discharge could be characterized as; serous discharge that is clear and thin which may be the tissue fluid, bloody discharge or purulent discharge due to infection, which may vary from yellow to brown, foul smelling discharge from the ear, usually a sign of infection or cholesteatoma, and yellow or brown fluid, also a sign of infection and in persistent infections, the discharge may be stained with blood and is usually thick and sticky (Woodfield and Dugdale, 2008).

Ear discharging infection is a common problem for both children and adults but the magnitude varies in different countries. Anatomically, the children's Eustachian tube is shorter, more horizontal with more fluid cartilage which can easily impair its opening and hence ear infection is a major health problem to them especially in those with poor socio – economic status (Bluestone and Klein, 2001). Ear infections such as chronic otitis media are of great concern especially in developing countries which can lead to serious morbidity and debility such as retarded language development and progress in school among children (Abubakar *et al.*, 2014). According to the World Health Organization record, 80% of all children have ear infections before the age of three, which represents 16 million annual episodes. In the US alone 20-30% of children have an average of 6 recurrences before the age of seven. Ear infections are the most common cause for a sick child visit to the doctor and accounts for half of all pediatric antibiotics. The World Health Organization attributes 28,000 annual deaths to complications resulting from ear infections (Derese *et al.*, 2016). In a study by Heidi *et al.* (2013), *H. influenza* was the dominant otopathogen detected in ear discharge swabs collected from children. In another study carried out by Mansoor *et al.* (2009) in Karachi, Pakistan,

Pseudomonas aeruginosa was the most common bacteria isolated from chronic discharging ears followed by *Staphylococcus aureus*.

There is relative high incidence of ear infection in Nigeria. Previous studies carried out at Kaduna, specifically at the National Ear Care Centre, Kaduna, have been retrospective analysis of ear infections (Abubakar *et al.*, 2014; Afolabi *et al.*, 2012; Aminu *et al.*, 2010). There is a need to carry out prospective study to ascertain the actual state of ear infection at the National Ear Care Center, Kaduna.

Materials and Method

Description of sample collection centre

The National Ear Care Centre is the only ENT Specialist Centre in Nigeria. It is a specialist hospital located along Golf Course road by Independence Way, Kaduna, Kaduna State. The Centre was established in 1999 as part of the World Health Organization (WHO) resolution of 1995 that recognized hearing impairment as a major health issue in Africa. The Centre was operating at the Yusuf Dantsoho General Hospital on borrowed facilities, before it was relocated to its permanent site. The new site (the former Psychiatric School of the Ahmadu Bello University Teaching Hospital, Kaduna) is currently operating with three consultants, two senior registrars, three physicians, ten ENT nurses, two anaesthetic and one theatre nurses. The Centre sources external ENT physicians and consultants to perform most of the Centre's activities that include surgeries, audiology, endoscopy, school hearing screening services, speech therapy, hearing aid services and industrial hearing conversation services.

Study population

Samples were taken from patients with discharging ears only using sterile swabs, from the month of July to September 2013. The subjects involved were both general outpatients and those on admission.

Sample collection and treatment

One hundred and one (101) samples were collected using sterile swab sticks and then worked on as quickly as possible in the Microbiology Laboratory at the National Ear

Centre, Kaduna. Those collected by the physician from the wards were also brought in without any further delay to avoid exposure and contamination.

Media preparation

The media used were blood agar, chocolate agar, MacConkey agar, Mannitol Salt Agar and Sabouraud's Dextrose Agar. They were measured and prepared according to the manufacturers' instructions. The dehydrated microbiological media were reconstituted into suspensions by weighing them, dispensing them into containers and then sterilized appropriately as described by the manufacturers.

Isolation and identification of the organisms

The samples collected were inoculated on to the prepared sterile media, using streak method to produce a defined colony pattern. Both the blood and chocolate agar were incubated aerobically and anaerobically at 37°C for 24 hours. SDA was incubated at 37°C and 25°C for 1 week, while the MacConkey agar and Mannitol Salt Agar were incubated at 37°C for 24 hours. The isolates were identified according to their morphological, cultural, physiological and biochemical characteristics. The tests used were: Gram reaction, Lacto-phenol cotton blue stain, Catalase, coagulase, methyl red, urease, citrate, indole and triple sugar iron tests as described by Cheesbrough (2006).

Antibiotic susceptibility test (Kirby-Bauer Disk Diffusion Method)

Antibiotics susceptibility test was carried out on all isolates using the commercially prepared Stoke's disc through disc diffusion technique. The test isolates were inoculated onto nutrient agar using spread method. Sterile forceps were used to pick the antibiotic disc and placed at the middle of the petri-dish and pressed gently with the forceps for the disc to stick properly to the media and also for absorption to take place. Antibiotic discs (Amoxycillin, amoxiclav, Cefuroxime, Ceftriaxone, Gentamycin, Ciprofloxacin, Ofloxacin, Erythromycin, Chloramphenicol, Cotrimoxole) manufactured by Biotec Lab. Ltd. (UK) were used. The plates

with the antibiotic discs were incubated at 37°C for 24 hours and the readings for zone of inhibitions were taken in mm to check for the reaction of the isolated organisms to the drugs (Cheesbrough, 2006). Results were interpreted according to Clinical and Laboratory Standards Institute (CLSI, 2012) guidelines. Multi resistance (non-susceptibility to at least three families of antibiotics) and antibiotic resistance index was calculated against the tested bacteria (Hala *et al.*, 2007).

Result

Out of the one hundred and one samples collected from the patients with discharging ears, 77.23% incidence rate of ear infection was recorded.

Distribution of Ear Discharge Infections based on age of the patients

High incidence of ear infection was recorded among children aged 0 – 5 years and low among subjects aged ≥ 71 as shown in Table 1.

Incidence Rate of Discharging Ear Infections

Out of the one hundred and one samples taken for the study, seventy-eight (78) of the patients had discharging ear infection as shown in Table 2.

Rate of Organisms Isolated

Of the total one hundred and one samples collected from July to September, 2013, fifty-seven (57) samples had single organisms and twenty-one (21) samples had multiple isolates as shown in Table 3.

Distribution of Organisms Isolated

Pseudomonas earuginosa was the most occurring with a frequency of 35.6% while the least was *Haemophilus spp* with 1% among the samples taken from July to September, 2013 as shown in Table 4.

Antimicrobial Resistance Profile of Isolates

Results of this study showed that the organisms isolated were more resistant to Cotrimoxazole with 81.13%, while minimum resistance (17.92%) to Ciprofloxacin was recorded as shown in Table 5.

Table 1: Age and gender distribution of patients with ear discharge in the National Ear Centre, Kaduna

Age (years)	Gender		Number of patients NO (%)
	Male	Female	
0 – 5	22 (21.8)	16 (15.8)	38 (37.6)
6 – 10	04 (34.96)	05 (4.95)	09 (8.9)
11 – 20	10 (9.9)	07 (6.9)	17 (16.8)
21 – 30	09 (8.91)	14 (13.96)	23 (22.7)
31 – 40	01 (0.98)	04 (3.96)	05 (5.0)
41 – 50	02 (1.98)	01 (0.99)	03 (3.0)
51 – 60	02 (1.98)	02 (1.98)	04 (4.0)
61 – 70	0 (0.0)	01 (0.99)	01 (1.0)
≥ 71	01 (0.99)	0 (0.0)	01 (1.0)
Total	51	50	101

Table 2: Incidence rate of discharging ear infection cases at the National Ear Centre, Kaduna

Description	Percentage (n=101)
Patients with ear discharge	100.00
Patients with no infection	22.77
Patients with one ear infected	52.48
Patients with both ear infected	24.75

Table 3: The Incidence rates of organisms isolated from the samples of ear discharge collected at the National Ear Centre, Kaduna

<i>Description</i>	<i>Percentage(n=101)</i>
Patients with ear discharge	100.00
Patients with no infection	22.77
Patients with single organism	56.44
Patients with multiple organisms	20.79

Table 4: Distribution of organisms isolated from discharging ear infection cases at the National Ear Centre, Kaduna.

<i>Organisms</i>	<i>Occurrence</i>	<i>Frequency (%)</i>
<i>Pseudomonas aeruginosa</i>	42	35.6
<i>Staphylococcus aureus</i>	37	31.4
<i>Staphylococcus epidermidis</i>	7	6
<i>Streptococcus spp</i>	7	6
<i>Candida spp</i>	7	6
<i>Escherichia coli</i>	6	5
<i>Klebsiellaspp</i>	6	5
<i>Proteus spp</i>	5	4
<i>Haemophilus spp</i>	1	1
Total	118	100

Table 5: Antibiotic resistance profile of isolated organism from discharging ear infection cases at the National Ear Centre, Kaduna

<i>Antibiotic</i>	<i>Resistance (R)</i>	<i>Intermediate Sensitivity (I/S)</i>	<i>Susceptibility (s)</i>	<i>Resistance %</i>
Amoxicillin	80	6	20	75.47
Amoxiclav	74	1	31	69.81
Cefuroxime	81	1	24	76.42
Ceftariaxone	76	0	30	71.70
Gentamycin	28	0	78	26.42
Ciprofloxacin	19	26	61	17.92
Ofloxacin	60	0	46	56.60
Erythromycin	79	10	17	74.53
Chloramphenicol	82	0	24	77.36
Cotrimoxazole	86	0	20	81.13

Table 6: Multiple Antibiotics Resistance Index of bacteria pathogens isolated at the National Ear Centre, Kaduna

<i>MARI</i>	<i>Percentage</i>	<i>(%)</i>
0.1	3	2.83
0.2	3	2.83
0.3	9	8.49
0.4	10	9.43
0.5	10	9.43
0.6	17	16.04
0.7	26	24.53
0.8	5	4.72
0.9	16	15.1
1.0	7	6.6
Total	106	100

Discussion

The results of this study show that the incidence of ear infection is age and gender related. The higher incidence in neonates, infants and children aged 0 – 5yrs, almost correlates with the study of Cook (2006) with peak incidence at 7–12yrs and Monasta *et al.* (2012) with peak incidence at 0 – 4yrs, but in contrast with the study of Ogbogu *et al.* (2013) carried out in Benin city, Edo, Nigeria that showed that age and gender did not significantly affect the prevalence of ear infection. The study carried out by Ekpo *et al.* (2009) showed that the infection is highest amongst ages 1 – 10yrs and lowest amongst ages 31 and above. Similar observations with this result carried out at the National Ear Care Centre, Kaduna, Nigeria. The study of Nnebe-agumadu *et al.* (2011) carried out at Abakiliki, Ebonyi, Nigeria also showed 73% of the cases were less than or equal to 5yrs with 41.5% of that being infants. Ilechukwu *et al.* (2014) also reported that prevalence was highest among 6 – 36 months age group.

Findings from this study showed that males had more ear infections than females which agree with the report of Nnebe-agumadu *et al.* (2011) and Simon (2002; 2004). This may be due to the fact that males are more exposed to the sources of

infection such as swimming in public baths, playing in contaminated soil, excessive moisture e.g. perspiration, trauma caused by insertion of foreign objects and eczema as shown in the research carried out by Ilechukwu *et al.* (2014); Cook (2006); Simon, (2002; 2004); Sander (2001) and Marshal (1967).

The result also proves that otitis media and otitis externa are recurrent infections among children aged 0 – 5yrs in accordance with Simon (2002; 2004) study which reported that about two-thirds of children do have at least one attack of otitis by age 3yrs and a third will have at least three episodes with most of the cases being unsuspected which may clear away leaving no sequel behind them at all (Brounlee, 1969; Froom, 1990).

The highest percentage of *Pseudomonas aeruginosa* isolated in this study could be due to the fact that, the organism is the major cause of otitis externa, because they are mainly found in soil and water. They are also opportunistic which attack an individual with impaired immune systems, in the case of the ear infections after exposure to hot tubs and swimming pools inadequately chlorinated or contaminated water

body or humid atmosphere. This result is similar to the findings of Nnebe-agumadu *et al.* (2011) at Abakiliki, Ebonyi state, Nigeria and Ogbogu *et al.* (2013) at Benin City, Edo State, Nigeria.

The presence of *Staphylococcus aureus*, *Streptococci spp*, *Staphylococcus epidemidis*, *Candida spp*, *Klebsiella spp*, *E. coli*, *Proteus spp* and *Haemophilis spp* as causative pathogens could be as a result of the fact that they are known to be responsible for causing otitis media or otitis externa directly or indirectly as secondary invaders (Ilechukwu *et al.*, 2014; Ogbogu *et al.*, 2013; Nnebe-agumadu *et al.*, 2011; Ekpo *et al.*, 2009; Udokpoh and Ubulom, 2005; Simon, 2002; 2004; Cook, 2006; Oni *et al.*, 2002; Sander, 2001; Brook, 1999; Marshal, 1969).

Though some of the antibiotics tested in this study exhibited good activities, prudent use of antibacterial agents is advocated except in some cases where the treatment in children may require the use of Ciprofloxacin especially in situations with limited access to laboratory services or specialist care (Nnebe-agumadu *et al.*, 2011).

This shows that the infection can be treated and controlled easily when diagnosed on time. The finding was in accordance with the studies of Marshall (1967) and Froom *et al.* (1990), though they have not been proved to be of long term benefit, as written by Simon (2002; 2004). The high resistance to most of the antibiotics by the organisms showed the development of the pathogens as reported by Froom *et al.* (1990). However, treatment of the infections with high dose of antibiotics covering *Pseudomonas spp* is effective as shown by Sander (2001) with the optimal duration of treatment being uncertain, though the 2, 3 and 4 days courses seem to be as effective as the 7 – 10 days course as presented by Froom *et al.* (1990).

Conclusion and Recommendations

An overall prevalence of 77.23% of culture positive ear discharge infection was observed with high bacterial isolates and majority being Gram negative bacteria. The predominant

isolates were *Pseudomonas spp* and *Staphylococcus aureus*. Most of the isolates showed a high level of antibiotic resistance and majority had multiple antibiotic resistant patterns. Therefore, evaluation of microbiological patterns and their antibiotic sensitivity is of great importance in prescribing empirical antibiotics for successful treatment of Otitis media and thus minimizing its complications and emergence of resistant strains.

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