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Microbiology of otitis media among children attending a tertiary hospital in Benin City, Nigeria

Philomena Ikharuonaemi Ogbogu[1,2]*, Nosakhare Odeh Eghafona[1] and Michael Izuwanneka Ogbogu[3]

[1]Department of Microbiology,University of Benin,Benin City, Nigeria.
[2]Department of Medical Microbiology,University of Benin Teaching Hospital,Benin City, Nigeria.
[3]Department of Health Services, University of Benin, Benin City, Nigeria.

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Otitis media has a worldwide prevalence. Though it is more common in children, the aetiologies and antibiogram varies with age, time and geographical location. A total of 220 children less than 18 years with signs and symptoms of otitis media were recruited for this study. Middle ear discharge were collected, processed and microbial isolates identified using standard microbiological techniques. Disc susceptibility tests were performed on bacterial isolates. Gender and age did not significantly affect the prevalence of otitis media pathogens (P = 0.8310 and P = 0.8272, respectively). *Pseudomonas aeruginosa* (33.33%) were the most prevalent microbial agent of otitis media followed by *Staphylococcus aureus* (23.19%) while *Citrobacter* species and *Aspergillus niger* were the least prevalent with a prevalence of 0.48% each. In relation to gender, *P. aeruginosa* were the most prevalent followed by *S. aureus* in males. In females, *S. aureus* (32.18%) predominated. Only *S. aureus* was significantly associated with female gender (odd ratio (OR) = 2.422 95% confidene interval (CI) = 1.261, 4.65, P = 0.0113). Tetracycline, erythromycin, cloxacillin and amoxicillin were poorly active against the bacterial isolates. Other antibacterial agents exhibited good activity against the bacterial isolates. In conclusion, an overall prevalence of 84.55% of culture-positive otitis media was observed in this study with *P. aeruginosa* as the predominant aetiologic agent. Though, the antibacterial agents exhibited good activities, prudent use of antibacterial agents are advocated.

Key words: Otitis media, children, tertiary hospital, Benin City.

INTRODUCTION

Otitis media is defined as the inflammation of the middle ear and is a common cause of children's visit to physicians (Li et al., 2001). The disease may be acute or chronic, suppurative and is usually recurrent. Otitis media is reported to be prevalent worldwide (Egbe et al., 2010) with an estimated direct and indirect cost of diagnosis and management exceeding 5 billion dollars annually Alsharaf et al., 1999).

Otitis media affects all age groups, but is more common in children (Li et al., 2001). The lower immunity(of children as compared to adult, the shorter and more horizontal Eustachian tube in children which permits easier access of microorganisms from the nasopharynx, and the fact that bacteria adhere better to epithelial cells of children than adults, have been suggested as possible reasons for the higher prevalence in children (Shimanura

*Corresponding author. E-mail: philogbogu@yahoo.com.

Table 1. Prevalence of otitis media in relation to gender and age.

Characteristic	No. tested	No. positive (%)	OR	95% CI	P value
Gender					
Male	129	108 (83.72)	0.8571	0.4046, 1.816	0.8310
Female	91	78 (85.71)			
Mixed infections					
Gender					
Male	129	12 (9.30)	0.9345	0.3764, 2.320	0.8838
Female	91	9 (9.89)			
Age (year)					
< 1 – 3	116	100 (86.21)			
4 – 6	45	37 (82.22)			
7 – 9	18	16 (88.89)	-	-	0.8272
10 – 12	15	12 (80.00)			
13 – 15	11	8 (72.73)			
16 – 18	13	(86.67)			

OR = Odd ratio; CI = confidence interval.

et al., 1990; Li et al., 2001). Other risk factors for otitis media include exposure to smoke, crowded living conditions and low socio-economic class (Li et al., 2001; Aich et al., 2009). These conditions are rife in resource-poor countries like Nigeria.

Aetiologic agents of otitis media include bacteria, fungi and viruses (Li et al., 2001), though bacterial agents of otitis media depends on age of individuals, geographical location and whether the infection is acute and chronic (Ogisi and Osamor, 1982; Herzon, 1992). Treatment is very necessary and urgent to prevent complications such as meningitis, septicaemia, amongst others (Schurtzman et al., 1991; Herzon, 1992). Therefore, periodic review of aetiologic agents of otitis media and their antimicrobial susceptibility profiles is warranted especially in this era of increasing microbial resistance. This study aims to determine the prevalence of otitis media among children, the effect of age and gender on this prevalence as well as determine the aetiologic agents and the susceptibility profiles of bacterial agents.

MATERIALS AND METHODS

Study population

The study was conducted at the University of Benin Teaching Hospital, Benin City, Nigeria. The hospital is a tertiary institution with a referral status. A total of 220 (129 males and 91 females) children less than 18 years with signs and symptoms of otitis media attending ear, nose and throat clinics in the hospital were included in this study. Patients on antibacterials within 7 days prior to specimen collection were excluded. Informed consent was obtained from parents or guardians of all children prior to specimen collection. Ethical approval for the study was obtained from the Ethics and Research Committee of the University of Benin Teaching Hospital.

Specimen collection and processing

Two sterile swabs were used to collect ear discharges from each patient. All specimens were transported to the laboratory and analyzed within 1 h of collection. One of the swabs was inoculated onto chocolate, blood and MacConkey agar plates. All plates were incubated aerobically at 37°C for 24 to 48 h except the chocolate agar plates that were incubated in a candle jar. The second swab was inoculated onto 2 Sabouraud agar plates. One was incubated at ambient temperature for 72 h and the other at 37°C for 24 h.

Emergent bacterial colonies were identified by standard bacteriological techniques (Barrow and Teltham, 2003), and disc susceptibility test performed by the BSAC method (Andrews, 2009).

All yeast isolates were identified with CHROMagarTM candida (Paris, France) (Paritpokee et al., 2005) and filamentous fungi were identified as previously described (Rippon, 1974).

Statistical analysis

The data were analyzed with Chi Square (χ^2) test and odd ratio analysis using the statistical software INSTAT® (GraphPad Software Inc., La Jolla, CA, USA).

RESULTS

A total of 186 (84.55%) out of the 220 patients were culture-positive. Although females (85.71%) had higher prevalence of culture–positive otitis media than their male counterparts (83.72%), the difference was not statistically significant (P = 0.8310). In a similar vein, the prevalence of mixed infections did not differ significantly between male and female genders (P = 0.8838) (Table 1).

Table 2. Distribution of microbial agents of otitis media in relation to gender.

Organism	Male (%)	Female (%)	Total (%)
Escherichia coli	3 (2.50)	2 (2.30)	5 (2.42)
Klensiella species	11 (9.17)	4 (4.60)	15 (7.25)
Enterobacter species	2 (1.67)	2 (2.30)	4 (1.93)
Citrobacter species	1 (0.83)	0 (0.00)	1 (0.48)
Proteus vulegaris	3 (2.50)	5 (5.75)	8 (3.86)
Proteus mirabilis	12 (10.00)	11 (12.64)	23 (11.11)
Providemcia species	4 (3.33)	4 (4.60)	8 (3.86)
Acinetobacter species	5 (4.17)	2 (2.30)	7 (3.38)
Alcaligenes species	3 (2.50)	2 (2.30)	5 (2.42)
Pseudomonas aeruginosa	47 (39.17)	22 (25.29)	69 (33.33)
*Staphylococcus aureus**	20 (16.67)	28 (32.18)	48 (23.19)
Candida albicans	8 (6.67)	5 (5.75)	13 (6.28)
Aspergillus niger	1 (0.83)	0 (0.00)	1 (0.48)
Total	120 (57.97)	87 (42.03)	207 (100.0)

*Female vs. male: OR = 2.422 95%; CI = 1.261, 4.651; P = 0.0113.

The prevalence of culture–positive otitis media decreased from 86.21% in the age range of <1 to 3 years to 72. 73% in the age range of 13 to 15 years and then increased to 86.67% in the age range of 16 to 18 years. However, age did not significantly affect the prevalence of culture-positive otitis media (P = 0.8272) (Table 1).

A total of 207 microbial isolates were recovered in this study. *Pseudomonas aeruginosa* (33.33%) were the predominant isolate causing otitis media. This was followed by *Staphylococcus aureus* (23.19%) while *Citrobacter* species and *Aspergillus niger* were the least aetiologic agent of otitis media with a prevalence of 0.48% each. In relation to gender, *P. aeruginosa* were the most common in males while *S. aureus* were the most common in females and only *S. aureus* was significantly associated with gender (odd ratio (OR) = 2.422 95% confidence interval (CI) = 1.261, 4.651; P = 0.0113) (Table 2).

The flouroquinolones showed moderate to good activity against all bacterial isolates. Erythromycin and tetracycline showed poor activity while gentamicin showed good activity against all bacterial isolates with the exception of *Escherichia coli.* Depending on the β-lactam, their activity against the bacterial isolates ranged from poor to good with imipenem being the most active (Table 3).

DISCUSSION

Risk factors for otitis media-exposure to smoke, crowded living conditions, low socio-economic class, malnutrition, poor hygiene, inadequate health care and recurrent upper respiratory tract infection (Li et al., 2001; Aich et al., 2009; Prakash et al., 2013), are rife in resource-poor settings. Children have been reported to be at higher risk (Li et al., 2001). Bacterial agents of otitis media and their antibiogram vary with age, geographical location, whether the infection is acute or chronic and time (Ogisi and Osamor, 1982; Herzon, 1992; Hassan and Adeyemi, 2007). Thus, necessitating periodic reviews to optimize treatment in order to prevent serious complications such as meningitis, septicaemia, intracranial abscess, etc (Prakash et al., 2003). Against this background, this study was conducted.

An overall prevalence of 84.55% of culture-positive otitis media was observed in this study. This prevalence was higher than previous studies in advance countries (Giebink, 1989; Maharjan et al., 2006). It has been reported that the prevalence of otitis media is higher in developing countries when compared with advanced countries and inaccessibility to health care facility, local customs and beliefs, harmful traditional practices and poor treatment of acute cases by the first contact health personnel have been suggested as possible reasons for the difference in prevalence (Lasisi and Ajuwon, 2001; Lasisi et al., 2002; Lasisi, 2008). However, the prevalence in this study is lower than that reported in Nigeria (95.5%) (Nwabaisi and Olige, 2002) and India (91.2%) (Prakash et al., 2013).

It is important to note that 15.45% of the specimens processed were culture-negative. Anaerobic bacteria, viruses, *Chlamydia trachomatis* and *Mycoplasma pneumonia* have been reported as possible pathogens of the middle ear (Block, 1998; Chonmaitree, 2000; Prakash

Table 3. Susceptibility profiles of bacterial agents of otitis media.

Organism	Antibacterial agents (µg/disc)										
	AMX (30)	**AUG (30)**	**CRO (30)**	**CAZ (30)**	**IPM (10)**	**OB (5)**	**CN (10)**	**TE (10)**	**E (10)**	**CIP (5)**	**OFX (5)**
Escherichia coli (n=25)	0 (0.0)	1 (5.0)	0 (0.0)	0 (0.0)	5 (100.0)	ND	0 (0.0)	0 (0.0)	ND	5 (100.0)	4 (80.0)
Klensiella species (n=15)	0 (0.0)	14 (93.3)	11 (73.3)	12 (80.0)	15 (100.0)	ND	13 (86.7)	1 (6.7)	ND	15 (100.0)	13 (86.7)
Enterobacter species (n=4)	0 (0.0)	3 (75.0)	4 (100.0)	4 (100.0)	4 (100.0)	ND	3 (75.0)	0 (0.0)	ND	4 (100.0)	4 (100.0)
Citrobacter species (n=1)	1 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)	1 (100.8)	ND	1 (100.0)	0 (0.0)	ND	1 (100.0)	1 (100.0)
Proteus vulegaris (n=8)	0 (0.0)	0 (0.0)	8 (100.0)	8 (100.0)	8 (100.0)	ND	8 (100.0)	0 (0.0)	ND	7 (87.5)	8 (100.0)
Proteus mirabilis (n=23)	0 (0.0)	0 (0.0)	18 (78.3)	20 (87.0)	22 (95.7)	ND	19 (82.6)	0 (0.0)	ND	21 (91.3)	14 (60.9)
Providemcia species (n=8)	0 (0.0)	6 (75.0)	5 (62.5)	6 (75.0)	8 (100.0)	ND	6 (75.0)	0 (0.0)	ND	2 (40.0)	5 (62.5)
Acinetobacter species (n=7)	0 (0.0)	5 (71.4)	7 (100.0)	7 (100.0)	7 (100.0)	ND	7 (100.0)	0 (0.0)	ND	5 (71.4)	5 (71.4)
Alcaligenes species (n=5)	0 (0.0)	3 (60.0)	5 (100.0)	5 (100.0)	5 (100.0)	ND	5 (100.0)	0 (0.0)	ND	2 (40.0)	2 (40.0)
Pseudomonas aeruginosa (n=69)	0 (0.0)	4 (5.8)	60 (87.0)	66 (95.7)	68 (98.6)	ND	50 (72.5)	0 (0.0)	ND	66 (95.7)	58 (84.1)
Staphylococcus aureus (n=48)	10 (20.8)	38 (79.2)	38 (79.2)	39 (81.3)	44 (91.7)	22 (45.8)	38 (79.2)	0 (0.0)	15 (31.3)	45 (93.8)	44 (91.7)

n = number tested; AMX = amoxicillin; AUG = amoxicillin – clavulanate; CRO = ceftriaxone; CAZ = ceftazidime; IPM = Imipenem; OB = cloxcillin; CN=gentamicin; TE = tetracycline; E= erythromycin; CIP = ciprofloxacin; OFX = ofloxacin. Figures in parenthesis are in percentages.

et al., 2013). Specimens in this study were not processed to recover these agents.

Polymicrobial infections are common in otitis media (Grebink, 1989; Chonmaitree, 2000) with mixed bacteria-bacteria and viral-bacteria infections commonly reported (Chonmaitree et al., 1986; Giebink, 1989; Jero and Karma, 1997). In this study, 9.55% of processed specimen were observed to be polymicrobic with bacteria-bacteria and bacteria-fungi infection observed.

The finding that gender did not significantly affect the prevalence of otitis media agrees with previous reports (Bluestone et al., 1992; Li et al., 2001) but disagrees with the report of Koksal and Reisli (2002). These conflicting finding have been noted recently, but the authors remarked that there were no anatomical differences in the ear structures of males and females (Prakash et al., 2013). This may explain the findings in this study.

The effect of age on the prevalence of otitis media varies from one study to the other. Some authors report that children less than 6 years to be more at risk of otitis media (Li et al., 2001), others report the age bracket of 13 to 15 years to have higher prevalence of otitis media (Maharjan et al., 2006). This study did not show any significant effect of age on the prevalence of otitis media. Perhaps children less than 18 years of age may not show age-related difference in the prevalence of otitis media. Indeed, Prakash et al. (2013) reported the prevalence of otitis media to be higher within the age range of 0 to 20 years.

The findings that *P. aeruginosa* was the most predominant isolate causing otitis media agrees with previous reports from Nigeria (Nwabuisi and Ologe, 2002; Oguntibeju, 2003) but differs from studies in developed countries where *Streptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis* predominate (Li et al., 2001; Koksal and Reisli, 2002). This may be due to geographical location which has been reported as one of the factors that determine bacterial agents of otitis media (Ogisi and Osamor, 1982; Herzon, 1992).

Irrespective of the type of bacterial isolates, flouroquinolones, imipenem, third generation cephalosporins and gentamicin (with the exception of *Escherichia coli)* were the most active antibacterial agents. Flouroquinolones are contraindicated in children (Egbe et al., 2011), gentamicin is toxic to patients with renal impairment while imipenem and the third generation cephalosporins (Ceftraxome and ceftazidme) are expensive. Therefore, prudent use of antibacterial agents is advocated.

In summary, an overall prevalence of culture-positive otitis media of 84.5% was observed in this

study. *P. aeruginosa* was the most predominated aetiologic agent of otitis media and rational use of antibacterial agents is advocated.

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