Microbial Profile In Children With Secretory Otitis Media In Zaria, Nigeria

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Abstract: Sixty (60) children with secretory otitis media and 60 age and sex matched controls were recruited for the study. Ear-discharge swabs were taken from children with secretory otitis media and cultured for microbial isolation and identification. Un-paired student t-test was used to compare the difference between the children with secretory otitis media and the control group, while Chi-squared test was used to determine association between the variables. Different microbial pathogens were isolated from the ears of those with otitis media in Zaria including *Staphylococcus aureus* (32.7%), *Pseudomonas aeruginosa* (20.0%), *Escherichia coli* (9.1%), *Proteus* spp. (9.1%), *Streptococcus pneumoniae* (7.3%), *Candida albicans* (5.5%), *Klebsiella pneumoniae* (5.5%), *Streptococcus pyogenes* (5.5%), *Corynbacterium diptheriae* (3.6%) and *Citrobacter fruindii* (1.8%).There is a paradigm shift in the aetiology of otitis media from the 3 most common organisms of otitis media to other microbial agents in this part of the world. Therefore, microbial identification should inform the choice of antibiotics before administration.

Keywords: Secretory Otitis Media, Zaria, Paradigm shift, Microbial agents

Introduction

Brough *et al.*, (2004) defined otitis media (OM) as the inflammation of the middle ear chamber. It is one of the most common childhood infections and the most frequent reason for antibiotic prescription to children (Rovers, 2008). Secretory otitis media (sOM) is, as defined by Sade *et al.*, (1989), a pathologic condition of the middle ear in which an effusion is present behind an intact ear drum without signs of acute inflammation. Otitis media is one of the most prevalent diseases of childhood and a major public health problem contributing to childhood mortality in developing nations (Leichtle *et al.*, 2011). One in ten children suffer from otitis media annually, about ten times the number of adults who suffer from the same condition annually (Virtual Medical Care, 2008).Adeleke *et al.*, (2009) in Zaria, identified some bacteria implicated in the aetiology of OM. These include *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Proteus mirabilis*, *Klebsiella pneumoniae*, and *Escherichia coli*.

Otitis media is a disease of concern in developing nations like Nigeria where medical resources are scarce and risk factors for middle ear infections like poor nutrition, overcrowded bed spaces, poverty, environmental pollution and infectious diseases are widespread. The aim of this research is to determine the microbial aetiopathological agents in otitis media in children in Zaria, Nigeria.

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Materials and Methods

This was a cross-sectional study conducted purposively in Hajiya Gambo Sawaba General Hospital Zaria and Ahmadu Bello University Medical Centre, Samaru Zaria Nigeria. Ethical clearance was obtained from the Kaduna State Ministry of Health Research Committee (with reference No. MOH/ADM/744/Vol. I). The formula $n=(z^2pq)/d^2$ was used to calculate the minimum sample size required for the study. With a prevalence rate of 1.53% from a study by Adeleke *et al.*, (2009), a confidence interval of 95%, a precision of 5% error margin and 10% attrition rate, the sample size was calculated to be 25 children. But to increase the power of the study, 60 children, about 2-fold of the calculated sample size were recruited in the study. Another set of 60 participants of the same age as the test group, who were apparently healthy and presented for routine vaccination were recruited as control. The children were within the age range of 0 months to 12 years, and those in the test group were diagnosed with chronic suppurative otitis media (CSOM) or otitis media with effusion (OME), which in the context of this study are referred to as secretory otitis media (sOM) from the ear(s) by physician/paediatrician in either of the hospitals. Informed consent was obtained from the parent/guardian of each of the participating children. Those that were clinically diagnosed with any form infection as of the time of sample collection, and those with known or suspected immunosuppressive illness were excluded from

the study. Ear discharge was collected aseptically from each of the discharging ears of the participants as described by Chernecky and Berger (2008). Gram staining and conventional microbial culture on media and identification by biochemical tests were carried out on the ear discharge swabs. McConkey, 5% sheep blood and chocolate media were used for that purpose. All data were collated into Microsoft excel® spreadsheet and analysed using Graphpad Prism (Version 5.03) statistical package.

Results

The mean ages of the test and the control groups were 4.4 ± 3.1 and 4.7 ± 3.3 years respectively. The 60 children with secretory otitis media comprised of 34 males and 26 females, while the 60 control children comprised of 33 males and 27 females. The highest occurrence in this region was seen in Hausas with 39(32.5%), with the Nupes having the least with 1(0.8%). Ninety four (78.3%) of the total 120 children studied were from the urban parts of Zaria and its environment. Thirty nine children (32.5%) were of school age and were attending school. The occurrence of otitis media did not depend on the number of children sleeping in the same room (Table 1).

Figure 1 shows the age group 0 – 5 years of age had the largest number of children with secretory otitis media with 42(70%), followed by the age group 6 – 10 years of age with 15(25%). The age group >10 years had the least number of participants with 3(5%).

Of the 60 children with secretory otitis media, 13(21.7%) presented with bilateral ear discharge. Only one of the children with bilateral ear discharge had mixed infection with *Escherichia coli* and *Corynbacterium diptheriae* while the remaining 12 children had single-organism infection in both ears. The remaining 47(78.3%) with unilateral ear discharge had single-organism infection. About ten (10) different organisms were isolated from culture of the ear discharge collected. *Staphylococcus aureus* had the highest frequency of isolation of 18(32.7%) which was followed by *Pseudomonas aeruginosa* with 11(20.0%), then *Proteus* spp. and *Escherichia coli* each with 5(9.1%), then *Streptococcus pneumoniae* with 4(7.3%), then *Streptococcus pyogenes*, *Klebsiella pneumoniae* and *Candida albicans* each with 3(5.5%), then *Corynbacterium diptheriae* with 2(3.6%). *Citrobacter freundii* was the least isolated organism with a frequency of only 1(2%). Six (10%) of the swabs collected from discharging ears of the children with secretory otitis media yielded no microbial growth (Figure 2).

Some of the children with sOM that presented with ear discharge were already on antimicrobial treatment as of the time of recruitment. Of those that did not yield any microbial growth in the culture plates, 2(3.3%) were on antibiotics while 4(6.7%) were not. Of those that yielded microbial growth, 5(8.3%) were on antibiotics while 49(81.7%) were not. There was no statistical relationship between antibiotic use and culture positivity (p=0.2835; $\chi 2$=1.150; df=1; OR=4.900; 95% CI=0.71 – 33.80) (Table 2).

Table 1: Socio-demographic and anthropometric data of children with secretory otitis media (sOM) and apparently healthy control (HC) children

Parameter		sOM (n=60)	HC (n=60)	*p*-value
Age (Years)	**(Mean ± SD)**	4.4 ± 3.1	4.7 ± 3.3	0.6087[a]
Gender (%)	**Male**	34(28.3)	33(27.5)	0.8541*
	Female	26(21.7)	27(22.5)	
Ethnicity (%)	**Hausa**	39(32.5)	33(27.5)	0.6327
	Fulani	14(11.7)	14(11.7)	
	Yoruba	4(3.3)	6(5.0)	
	Igbo	2(1.7)	4(3.3)	
	Nupe	1(0.8)	3(2.5)	
Place of Residence	**Urban**	48(40.0)	46(38.3)	0.8246**

(%)	Rural	12(10.0)	14(11.7)	
Attending School (%)	**Yes**	18(15.0)	21(17.5)	0.6967***
	No	42(35.0)	39(32.5)	
No. of people per room (Overcrowding) (%)	**0**	28(44.4)	35(55.6)	0.5437[α]
	1	16(66.7)	8(33.3)	
	2	9(64.3)	5(35.7)	
	3	3(60.0)	2(40.0)	
	4	3(42.9)	4(57.1)	
	>4	1(14.3)	6(85.7)	

[α]Determined by two-tailed Student t-test.
*Chi-squared test for independence (OR = 1.070 (95% CI = 0.5203 to 2.200); χ^2=0.03379; df=1).
**Chi-squared test for independence (OR = 1.217 (95% CI = 0.5096 to 2.908); χ^2=0.04910; df=1).
***Chi-squared test for independence (OR = 0.7959 (95% CI = 0.3700 – 1.712); χ^2=0.1519; df=1).
[α]Chi-squared for linear trend (χ^2=0.3688; df=1).
[#]Statistically significant difference

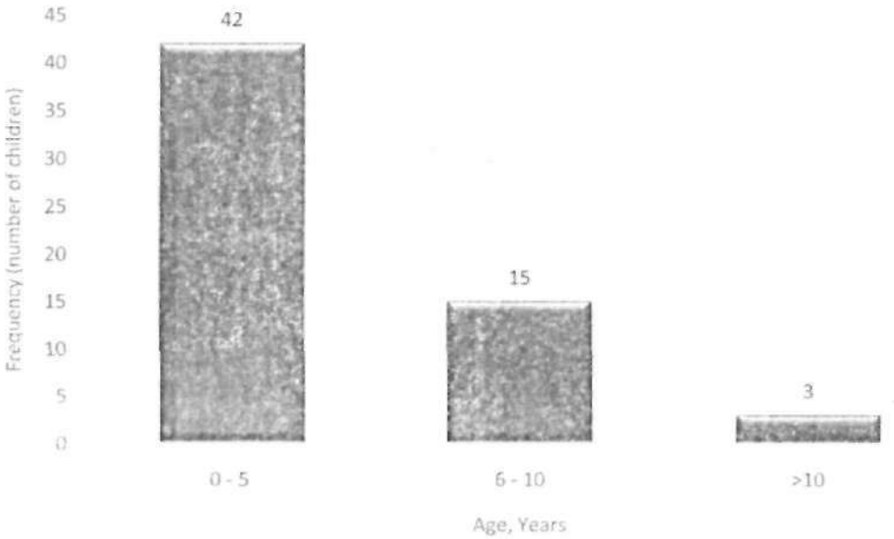

Figure1: Frequency distribution of children with secretory otitis media according to age group

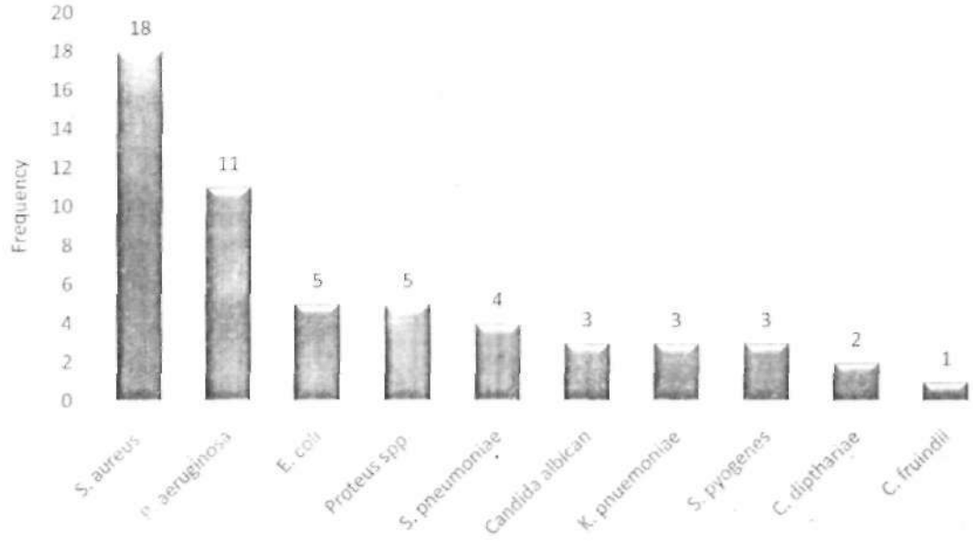

Figure 2: Frequency distribution of the organisms isolated from children with secretory otitis media in Zaria, Nigeria

Table 2:Relationship of antibiotic usage with culture growth yielding in children with secretory otitis media (sOM) in Zaria, Nigeria

		Culture		Total
		Negative (%)	Positive (%)	
Antibiotic use	Yes	2(3.3)	5(8.3)	**7(11.7)**
	No	4(6.7)	49(81.7)	**53(88.3)**
Total		**6(10.0)**	**54(90.0)**	**60(100)**

p=0.2835; χ^2=1.150; df=1; OR=4.900; 95% CI=0.71 – 33.80

Discussion

Most studies conducted on otitis media in a general population presented with higher frequencies of children as compared to the adults which constitute a smaller number. This has redirected the attention of most researches on otitis media to commit all resources on children as the target group, and so, this study targeted children of age range 0 years to 12 years. The frequency of occurrence of secretory otitis media was observed to be the highest in children within the age group 0 – 5 years of age. This is in line with the findings of a community survey in Osun state of Nigeria by Amusa *et al.* (2005) which identified the age group 1 – 4 years as having the highest incidence range. It also agrees with the findings of Adeyi *et al.* (2010) which identified the age group 1 – 5 constituting 55.4% of the total number studied. Children of 0 – 5 years are thus more likely to have otitis media compared to children of 6 – 10 years and children of above 10 years of age. This could be ascribed to the fact that the eustachian tube in these children is shorter, floppier, more horizontal, and with a tinier opening that is easy to block (Bluestone and Klein, 2007). More importantly, the immune system at this age is still developing (American Academy of Paediatrics, 2004; Smith-Vaughan, 2006; Bluestone and Klein, 2007). These anatomical and immunological factors could explain the distribution and occurrence pattern of secretory otitis media which decreases with increasing ages of the children, in that as they grow older, their anatomy matures and immunity increases and fully develops.

According to Rothstein *et al.* (2007), a number of factors such as gender, nutritional status, overcrowding and early exposure to otopathogens among others, predispose children to otitis media. Factors such as overcrowding the sleeping room, gender etc. were observed in this study among the participating children. It was observed that occurrence of secretory otitis media

in this environment is independent of the gender of the child. This could be attributed to the fact that at young age, there is no recorded specific baseline immunity difference between the two genders. Both innate and adaptive responses in normal immune competent children are the same and independent of gender. It was also observed that there was no statistical relationship between the occurrence of otitis media and the increasing number of children sleeping in the same room. This could be because the number and the size of the sleeping room were not considered which could be a factor to reckon with.

Microbial culture of the ear discharge yielded different organisms viz: *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Proteus* spp., *Candida albicans* etc. with different frequencies. This agrees totally with the findings of Iseh and Adegbite (2004) in Sokoto, Adeleke *et al.* (2009) in Zaria and Abo el-Magd *et al.* (2015) in Egypt where they all identified *Staphylococcus aureus* as the most prevalent organism in otitis media.

The distribution of all the organisms isolated in this study was independent of the place of residence of the children studied, and the cellular immune response in culture-positive cases of secretory otitis media did not differ from the culture-negative cases. The culture-negative cases could have developed their ear discharge due to prolonged negative pressure within the middle ear which, according to Bluestone and Klein (2007), can cause a sterile middle ear effusion. This is however, very unlikely in this study considering that cellular immune response in culture-negative cases was similar to what obtains in culture-positive cases. A rational explanation is the children might have viral infections rather than bacterial or fungal infections. Although it was determined in this study that culture negativity was not associated with antibiotic use, it is still an indispensable fact that the effect of antibiotics (oral or eardrop) on the microbes exist. Also, the inability to access the ideal choice of culture media for each particular bacteria specie was a shortcoming of the study which could have affected microbial isolation.

Conclusion and Recommendations

A paradigm shift in the aetiology of otitis media is observed from *Streptococcus pneumoniae, Moraxella catarrhalis and Haemophilus influenzae* to *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Proteus* species and even fungal elements like *Candida albican* in this part of the world. Therefore, rather than administering antibiotics targeting the 'common dogma' of *S. pneumoniae, M. catarrhalis* or *H. influenzae* as aetiological agents of otitis media, microbial identification should be conducted to inform the choice of antibiotic.

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