Original Article

Observations on the Current Bacteriological Profile of Chronic Suppurative Otitis Media in South Eastern Nigeria

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Abstract

Background: Chronic suppurative otitis media (CSOM) is a disease well-known for its recurrence and persistence despite treatment. The situation is compounded by the increasing resistance to antimicrobial agents by bacteria these days. **Aim:** This study was carried out to examine the current local bacteriological profile of CSOM and to compare the profile of either ear in bilaterally discharging ears. **Materials and Methods:** We carried out a retrospective analysis of ear swab cultures from 133 unilateral and 73 bilateral consecutive tubotympanic CSOM cases seen at the Ear-Nose-Throat clinics of a referral health institution during a 4 year period ending 2013. Sensitivities to eight locally available antibiotics were analyzed. Aerobic bacterial isolates were analyzed separately for the unilateral and bilateral cases. Comparison was made between the ears in the bilateral cases. **Results:** We analyzed 279 ear swab culture results from 206 patients with age ranging from 5 months to 86 years and a mean of 21.3 (19.5) years. *Pseudomonas aeruginosa* was the most common isolated bacteria (44% [109/250]) followed by *Staphylococcus aureus* (17% [42/250]), and *Proteus Mirabilis* (15% [38/250]). The most and least sensitive bacteria were *Klebsiella Spp* and *Escherichia Coli,* respectively. The most effective antibiotics were gentamicin and ciprofloxacin. The two ears differ significantly in the rates of isolation of *S. aureus* and *E. coli* ($P = 0.01$ and $P = 0.04$, respectively). **Conclusion:** Pseudomonas is the most common bacteria involved in CSOM in this part of the country. Ciprofloxacin as ear drops is recommended as first-line drug in the management of active CSOM as it is cheap, less ototoxic, and locally available. Separate ear swab culture should be obtained in bilateral CSOM.

Keywords: Bilateral, Chronic, Culture and sensitivity, Otitis Media, Pseudomonas

Introduction

Chronic suppurative otitis media (CSOM) is the most common infection of the ear characterized by persistent or recurrent purulent drainage from the middle ear through a persistent nonintact tympanic membrane. Although it is a global disease, its incidence has remained relatively higher in resource-poorer countries.[1-4] Often, the primary care physicians are usually the first to see these patients and mostly rely on empirical antibiotic therapy and only refer to the otolaryngologist when their treatments fail. Due to its recurrent nature and the development of resistant pathogenic organisms, control of infection poses a greatest therapeutic challenge. The challenges of resistance have even been compounded by the activities of quacks in this part of the country where they engage in uninformed administration of antibiotics to these patients. These days, it is rare for an otolaryngologist to encounter bacterial flora of a chronic discharging ear that has not already been modified by previous antibiotic therapy with some of them returning sterile cultures.[5] Knowledge of the local microbiological flora in CSOM is essential for initiating empirical therapy pending culture results, making it mandatory for periodic surveillance of microbiological profile and sensitivity pattern in CSOM. Moreover, there is a need to ascertain whether the microbial floras between both ears in bilaterally discharging ears are similar. The objective of our study was to examine

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our current bacteriological profile and antibiotic sensitivity pattern to locally available antibiotics in tubotympanic CSOM; as well as to compare the bacteriological profile of either ear in bilaterally discharging ears.

Materials and Methods

We conducted a retrospective analysis of consecutive new cases of clinically diagnosed CSOM seen in the Ear-Nose-Throat Outpatient Department of a Tertiary Institution during a 4 year period ending 2013 using our medical record database after permission for the use of patients' records was granted by the department of medical records (For retrospective study requiring the use of only patient records in our institution, permission for the study is normally granted by the medical records department without recourse to approval by the hospital ethical review committee). Those included had active ear discharge in one or both ears for at least 3 months and from who ear swab specimens were sent for microscopy and culture at our Microbiology Department. Patients with recent history of ear trauma preceding the otorrhea, HIV and diabetic patients, as well as those found to have atticoantral disease were excluded from the study. Details including the history and relevant findings were retrieved from the patients' records which included otoscopic examination findings.

Collection of specimen

Swab samples were collected from the discharging ears by inserting a sterile specimen stick deep in the canal. The collected samples were enclosed in airtight plastic tubing and then transported to the microbiology test laboratory. The samples were always taken before cleaning/suctioning the ear canals of the excess purulent exudates. Samples from bilaterally discharging ears were collected separately. The swabs were inoculated on MacConkey agar plates and incubated for 48 h. The agar plates were examined after 24 and 48 h. The plates showing no growth at 48 h were recorded as negative cultures. Bacteria showing growth were identified by standard techniques based on morphological, cultural, and biochemical characteristics. Culture for anaerobic organisms was not performed in this present study. Antimicrobial sensitivities were carried out using standard disc diffusion technique of Bauer *et al*.[6]

Statistical analysis

The Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 16 was used for analysis. Chi-square test was used to test the statistical significance of the association between potential variables.

Results

Among the 206 CSOM cases studied, 133 were unilateral cases (64.6% [133/206]) while bilateral CSOM were recorded in 73 patients (73/206 [35.4%]), thereby making a total of 279 ear cultures available for analysis. Their ages ranged from 5 months to 86 years with a mean of 21.3 (19.5) years. Fifty-two percent were children aged 5 months to 15 years. Those aged <5 years constituted 23.8% (49/206), whereas 5.8% (12/206) were <1 year of age. The males accounted for 55.3% (114/206) of the patients with a male to female ratio of 1.2:1.

Bacterial isolates

The rates of bacterial isolation in this study were outlined in Table 1. The culture samples of 250 ears (89.6% [250/279]) were positive. *Pseudomonas aeruginosa* was the most common isolated bacteria (44% [109/250]), followed by *Staphylococcus aureus* (17% [42/250]), and *Proteus Mirabilis* (15% [38/250]). Comparing the bacteriology in either ear in the 73 patients with bilateral CSOM, the pattern of bacterial isolates differed significantly between *S. aureus* and *Escherichia coli* ($P = 0.01$ and $P = 0.04$, respectively). Whereas the second most isolated bacteria were by far *S. aureus* in the right ear, it was *E. coli* in the left ear.

Antibiotic susceptibility test

Table 2 summarizes the list of organisms isolated against their percentage susceptibility in the 250 positive cultures. Overall, the most effective antibiotics were gentamicin (76%) followed by ciprofloxacin (72%). However, Gram-negative organisms showed more susceptibility than Gram-positive to both antibiotics. The Gram-positive bacteria tended to show more susceptibility to ceftriaxone and amoxicillin/clavulanic acid combination, though the later was among the least effective antibiotics along with ampicillin and cloxacillin. Overall, the most resistant organism was *E. coli* which showed 100% resistance to three of the tested antibiotics, and its highest sensitivity was only 54% to gentamicin. Among the gram-negatives, *Klebsiella spp*. showed the best sensitivity pattern to most of the tested antibiotics. *Pseudomonas* isolates showed complete (100%) resistance to ampicillin and cloxacillin, but it showed high sensitivity to gentamicin (82%) and ciprofloxacin (78%). The highest sensitivities to ciprofloxacin were shown by *Klebsiella spp*. (100%) and *Proteus mirabilis* (94%).

Table 1: Bacteriology of middle ear swabs of 133 unilateral and 73 bilateral CSOM *n*=279 cultures

Isolated species	Number of isolates (%)		
	Unilateral CSOM	Bilateral CSOM	
		Right ear	Left ear
Pseudomonas aeruginosa	47 (35.3)	33 (45.2)	29 (40.3)
Klebsiella spp.	14 (10.5)	4 (5.5)	7 (9.7)
Staphylococcus aureus	21 (15.8)	17 (23.3)	4 (5.5)
Proteus mirabilis	27 (20.3)	5 (6.8)	6 (8.3)
Escherichia coli	12 (9.0)	3 (4.1)	10 (13.7)
Streptococcus spp.	8 (6.0)	-	3 (4.2)
No growth	4 (3.0)	11 (15.1)	14 (19.2)

CSOM: Chronic suppurative otitis media

Table 2: Sensitivity pattern of both gram-negative and positive bacteria isolates to commonly available antibiotics

Organisms	Antimicrobials (%)							
	Ampicillin	Cloxacillin	Amoxicillin/ clavulanate	Gentamicin	Ceftriaxone	Erythromycin	Ciprofloxacin	Ofloxacin
Pseudomonas aeruginosa	0	0	1.8	82.5	54.3	6.5	78.1	6.2
Escherichia coli	0	0	6.7	56.4	41.2	0	45.8	3.1
Klebsiella spp.	2.3	0	34.2	100	73.3	37.2	100	54.1
Streptococcal spp.	18.2	23.8	41.2	32.9	100	54.2	58.9	42.0
Proteus mirabilis	0	1.8	16.0	100	62.6	28.2	94.0	27.2
Staphylococcus aureus	6.2	27.3	100	83.8	100	19.7	54.3	8.3
Total	4.5	8.8	33.3	75.9	71.9	24.3	71.9	23.5

%: Percentage sensitivity of a number of organisms tested

Table 3: Comparison of antibiotic sensitivity patterns of most common isolated organisms between the right and left ears in the 73 patient with bilateral CSOM

Antibiotics	*Pseudomonas aeruginosa* *n* (%)		*Staphylococcus aureus* *n* (%)		*Escherichia coli* *n* (%)	
	Right ear	Left ear	Right ear	Left ear	Right ear	Left ear
Ampicillin	0/33 (0)	0/29 (0)	3/17 (18)	1/4 (25)	0/3 (0)	0/10 (0)
Cloxacillin	0/26 (0)	0/27 (0)	5/17 (29)	2/4 (50)	0/3 (0)	0/10 (0)
Amoxicillin/clavulanate	5/31 (2)	7/29 (2)	16/17 (94)	3/3 (100)	1/3 (33)	0/10 (0)
Ceftriaxone	23/32 (72)	13/29 (45)	15/17 (88)	4/4 (100)	1/3 (33)	4/10 (40)
Erythromycin	2/33 (6)	2/28 (7)	4/17 (24)	1/4 (25)	0/3 (0)	0/13 (0)
Ciprofloxacin	28/33 (85)	21/29 (72)	11/15 (73)	1/4 (25)	1/3 (33)	7/10 (70)
Ofloxacin	4/31 (13)	1/29 (3)	2/17 (12)	0/4 (0)	0/3 (0)	1/10 (10)
Gentamicin	17/32 (53)	25/29 (86)	14/17 (82)	4/4 (100)	2/3 (67)	6/10 (60)

n: Number of susceptible cultures/number of tested cultures, %: Percentage of sensitive isolates, CSOM: Chronic suppurative otitis media

The antibiotic sensitivities of the most commonly isolated organisms in the bilateral cases were compared between the ears in Table 3. Although there is fairly close similarity between both ears in relation to the antibiotic susceptibility pattern overall, the sensitivity of *S. aureus* and *E. coli* to ciprofloxacin differ significantly between the right and the left ears ($P = 0.01$ and $P = 0.04$, respectively). Similarly, the rates of sensitivity of *P. aeruginosa* in both ears to ceftriaxone and gentamicin were significantly different ($P = 0.05$ and 0.01, respectively).

Discussion

Chronic Suppurative otitis media are a common disease with approximately 5% global incidence.[1] It is characterised by chronic inflammation of the middle ear cleft with recurrent ear discharge through a persistent perforated ear drum. The chronic inflammation results from the presence of bacteria in the middle ear and mastoid cavity. Bacteria are believed to gain access to the middle ear cleft either from the external auditory canal through the perforation or from the nasopharynx via the eustachian tube or both. But regardless of the entry mechanism, biofilm formation has been suggested to explain the recalcitrant nature of CSOM.[7] The susceptibility of organisms causing CSOM to antibiotics changes considerably from time to time and this variation is even worsened by misuse of antibiotics, which tend to create multidrug resistance among the organisms, thereby making the management of CSOM more difficult.[7-9] Often, it is common in the otologic practice to see actively discharging ears yielding sterile cultures in view of previous antibiotic therapy which had modified the bacterial making treatment problematic.[10,11] For rational antibiotic use and successful of treatment of CSOM, an appropriate knowledge of antibacterial susceptibility of causative microorganisms is imperative.

The results of this study showed that overall *P. aeruginosa* was the most common aerobic isolate in CSOM followed by *S. aureus* which is in agreement with the reports of some other investigators in different parts of the worlds.[8,11,12] However, when unilateral ears were considered separately, it was found that *P. aeruginosa* was still the commonest isolated bacteria, but was followed by *P. mirabilis*. Madana *et al*. similarly documented *P. mirabilis* as the second most common bacteria isolate[7] in their series. In one study, however, *S. aureus* was reported as the most common isolated microorganism in 117 CSOM cases.[10] This, therefore, implies that sole reliance on empirical antibiotic therapy is not appropriate for effective treatment of CSOM. As a policy, bacteriological study and antibiotic sensitivity should be obtained for every CSOM patient so that specific antibiotic therapy will be tailored to the individual cases. In our study, 10.4% of the cultures did not yield any microbial growths which is compatible with the findings in other reports in which negative cultures were also documented.[5,10,11] Such negative cultures may have been as a result of the modification of the bacterial flora in the affected ears by prior empirical antibiotic therapy.

Our study also showed that more than 35% of the patients had bilateral CSOM, which agrees with the report of other investigators from a developing country.[13] We found that the bacteriology profile in both ears were fairly comparable in these bilateral cases except for *S. aureus* and *E. coli*, that demonstrated significant different rates of isolation between the two ears. Similarly, in a study that compared the bacteriology of bilateral CSOM, difference rates of isolation of *E. coli* between the two ears was also documented.[5] It is, therefore, beneficial to carry out separate bacteriological studies in bilateral CSOM so that such differences will be identified, and specific treatment offered to the individual ears.

The sensitivities of most bacteria isolated in this study are comparable to the reports of most investigators. Most of the investigators reported high sensitivity rate for *Pseudomonas* and *Staphylococci spp*. to ciprofloxacin,[5,9,12,14,15] though emergence of ciprofloxacin-resistant *Pseudomonas* in CSOM is being reported.[16] Overall, we found that the most effective antibiotics tested was gentamicin (Aminoglycoside) followed by ciprofloxacin, which is in agreement with the report of other investigators in which the sensitivities to aminoglycosides (Amikacin and Gentamicin) approach 100%.[5,8,15] However, in other reports, ciprofloxacin was found to be the most effective antibiotics.[10,12,14] Since pseudomonas is by far the predominant bacteria isolated in most CSOM and is mostly highly sensitive to ciprofloxacin which has none of the ototoxic risks of aminoglycosides, it may be beneficial to concluded that ciprofloxacin ear drops be adopted as a first line antimicrobial treatment for CSOM. Amoxicillin/clavulanate combination was found to be among the least effective antibiotic. Incidentally this antibiotic enjoys high patronage by general duty physicians, being the most often prescribed empirical antibiotic in CSOM in our experience.

The most resistant organism in this study was *E. coli* which showed 100% resistance to three of the tested common antibiotics, and even <50% sensitive to ciprofloxacin. This agrees with results of other investigators.[5,10,15] In one series, it was 100% resistant to nine of the tested 11 antibiotics including ciprofloxacin.[5] Fortunately, its rate of isolation in this series was only 10% (25/250). The rate of isolation of *E. coli* in most reports is often <10%,[5,8,10,11,14,15] and rarely up to 20%.[12] Our study is limited by using retrospective design especially in respect of encountering a lot of incomplete critical data in the patients records regarding details of mixed bacteria flora and their antibiotic sensitivities. In some earlier cases, notes were found to have been destroyed and we could not accurately estimate the actual prevalence of the individual bacterial isolates.

Conclusion

Pseudomonas aeruginosa was the most common isolated bacteria in both unilateral and bilateral CSOM and was highly sensitive to gentamicin and ciprofloxacin antibiotics. Amoxicillin/clavulanate combination, being the most commonly prescribed empirical antibiotic by primary care physicians was found to be among the least effective antibiotic. In this era of increasing resistance to antimicrobial agents by bacteria, a periodic surveillance of bacteriological profile is essential for effective management of CSOM.

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