Acta Scientific Otolaryngology (ISSN: 2582-5550)

Volume 6 Issue 5 May 2024

Research Article

Emerging Trend in the Bacteriology of Chronic Suppurative Otitis Media in South-Eastern Nigeria

Evaristus E Afiadigwe[1]*, Ugochukwu S Umeh[1], Iloduba N Aghanya[2], Josephat C Akabuike[3] and Nnaemeka G Umedum[4]

[1]Department of Otorhinolaryngology, Nnamdi Azikiwe University /Teaching Hospital, Nnewi, Anambra State, Nigeria

[2]Department of Medical Microbiology and Parasitology, Nnamdi Azikiwe University/ Teaching Hospital, Nnewi, Anambra State, Nigeria

[3]Department of Obstetrics and Gynaecology, Chukwuemeka Odumegwu Ojukwu University/ Teaching Hospital, Awka, Anambra State, Nigeria

[4]Department of ENT, Chukwuemeka Odumegwu Ojukwu University/ Teaching Hospital, Awka, Anambra State, Nigeria

***Corresponding Author:** Evaristus E Afiadigwe, Department of Otorhinolaryngology, Nnamdi Azikiwe University/ Teaching Hospital, Nnewi, Anambra State, Nigeria.

Received: February 25, 2024

Published: April 16, 2024

Abstract

Background: Chronic suppurative otitis media (CSOM) is a prevalent otolaryngological disease of public health importance. Antibiotics use in its management should be evidence guided. We aimed to profile the bacterial pathogens causing this disease and their susceptibility patterns in our locality to guide empirical antibiotics usage.

Methods: This was a prospective study conducted at a specialist Otorhinolaryngology clinic located in Anambra state, south Eastern Nigeria over 5 years. Ear swab specimens obtained from patients diagnosed clinically with Chronic suppurative otitis media were sent to the laboratory for microscopy, culture and sensitivity tests

Results: Out of 3,520 patients that presented to the clinic during the period under review, 414 were managed for CSOM, giving a prevalence of 11.8. The commonest age category affected in this study was young adults (18-30 years) which constituted 22.5%. Infants were the least affected, making up only 1.45%. Organisms cultured included coliform (30.2%), Pseudomonas species (19.3%), Staphylococcus aureus 17.6%, Proteus species (2.4%), Klebsiella species (1.4%), Streptococcus species (1%), while 28% yielded no growth. Gentamycin showed the highest sensitivities to the bacterial isolates (23.1%), while the least sensitive antibiotic was cefuroxime (0.29%). Others were Chloramphenicol (16.59%), Amoxiclav (13.4%), Ofloxacin (11.5%), Ciprofloxacin (9.89%), Cefixime (7.7%), Erythromycin (6.55%), Levofloxacin (6.4%), Streptomycin (3.93%) and Amoxicillin (0.5%).

Conclusion: We recorded a different pattern of bacterial culture and sensitivity of middle ear discharge from patients with CSOM in comparisom to other literatures. Widespread antibiotic abuse could be responsible for this trend. Specific and appropriate antibiotics use should always be emphasized to prevent resistance and treatment failures.

Keywords: Bacteriology; Culture; Sensitivity; Chronic; Otitis Media

Introduction

Chronic suppurative otitis media (CSOM) is a persistent infection of the middle ear that is characterized by the presence of purulent discharge and permanent tympanic membrane perforation [1,2]. It is a common condition, particularly in developing countries, and can have significant implications for the affected individuals. Understanding the bacteriology of CSOM is crucial for the effective management and prevention of complications associated with this condition [3-6].

Several studies on the microbiological profile of CSOM have been conducted, and it has shown that the aetiology of this disease is multifactorial. *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Proteus mirabilis* are the commonest pathogens associated with the disease. The incidence of these species, however, varies depending on the geographical region and population being studied [3,7]. *Staphylococcus aureus* is a gram-positive bacterium that is frequently isolated from CSOM cases. It is known to produce various virulence factors, including exotoxins and enzymes that contribute to the pathogenesis of the infection [3,8-10]. *Pseudomonas aeruginosa*, on the other hand, is a gram-negative bacterium that is often associated with more severe cases of CSOM. It is known to produce a variety of toxins and enzymes that can cause tissue damage and impair the host's immune response [10-12]. Proteus mirabilis is another common pathogen isolated from CSOM cases. It is a gram-negative bacterium that is capable of producing biofilms, which can contribute to the chronicity of the infection [13,14]. Biofilms are complex communities of microorganisms that are embedded in a self-produced extracellular matrix. They protect the bacteria, making them more resistant to antibiotics and host immune responses [15].

In addition to these commonly isolated pathogens, other bacteria such as *Haemophilus influenzae, Streptococcus pneumoniae*, and anaerobic bacteria have also been associated with CSOM. The disease aetiology is usually polymicrobial, further complicating the management of this condition [2,16].

The presence of these microorganisms in CSOM can have a variety of consequences for those who are affected. For instance, the chronic inflammation generated by these bacteria can cause irreversible damage to middle ear structures such as the ossicles and tympanic membranes. This can result in conductive hearing loss, which can have a substantial impact on the individuals' quality of life. Furthermore, the presence of these bacteria might cause complications such as mastoiditis, labyrinthitis, and cerebral infections. These conditions can be fatal and require prompt medical attention [17].

Effective management of CSOM requires an in-depth knowledge of the bacteriology of the condition, which includes identifying the pathogens involved, their antimicrobial susceptibility patterns, and the presence of any biofilms [16]. Culturing the middle ear discharge and performing antimicrobial susceptibility testing can help guide appropriate antibiotic therapy.

The bacteriology of chronic suppurative otitis media is complex and involves a wide range of pathogens. *Staphylococcus aureus, Pseudomonas aeruginosa*, and *Proteus mirabilis* are commonly isolated organisms, but the prevalence of these pathogens can vary. Understanding the microbial profile of CSOM is essential for the appropriate management and prevention of complications associated with this condition [3,4,7,10].

We, therefore, aim to identify the microbiological isolates causing CSOM in our locality and then determine the antibiotic sensitivity patterns of these organisms.

Materials and Methods

This was a prospective study conducted at a specialist ENT clinic located in Anambra state, South Eastern Nigeria. The study spanned a period of five years; from July 2018 to June 2023.

The study population included patients who have had recurrent or persistent ear discharge for or greater than a period of three months. All consenting patients were recruited for the study, and parents of minors were required to give consent. A proforma was designed to record the patients' details which included age, sex, ear involved, organism cultured and antibiotics sensitivity. Patients who didn't give consent or those with ear discharge less than three months were excluded from the study.

Ethical approval was obtained from the Chukwuemeka Odumegwu Ojukwu University Teaching Hospital research ethics and advisory committee with a reference number; COOUTH/CMAC/ETH.C/Vol.1/FN:04/314.

Non-duplicate ear swab specimens were collected by the same individuals after cleaning the outer ear with chlorhexidine solution and ethyl alcohol. The discharge from the middle ear was obtained using a sterile swab stick under good illumination and the ear swabs were immediately transported to the Medical Microbiology laboratory for microscopy, culture and sensitivity tests. Each ear swab was inoculated on blood agar, chocolate agar and Mc Conkey agar plates all manufactured by Oxoid, UK, and incubated for 24 hours at 35 ± 2^0C. Following incubation, the colonial morphologies of the isolates were recorded, and each isolate was then subjected to microscopy using the Gram staining technique. Further identification using various biochemical tests was conducted on each isolated organism, depending on their Gram staining reactions. Following the identification of the isolates, each isolate was then subjected to antimicrobial susceptibility testing using the Kirby Bauer disc diffusion method. Various antibiotic discs were used to determine the susceptibility pattern of the isolates. Antibiotic selection was done based on previously published work as well as recommendations by the Clinical and Laboratory Standard Institute [18].

Data analysis was done using the SPSS version 25 software package and results are presented in tables and charts.

Results

A total of 3520 cases were seen at the Otolaryngology outpatient clinic of Eastern Specialist Surgical Clinics, Nnewi during the period under review, out of which 414 participants were treated for CSOM and thus participated in the study, giving a prevalence of 11.8%. The ratio of males (51%) to females (49%) was 1:1.04. The age of participants ranged from 2 months to 90 years with a mean age of 26.7 years. The commonest age category in this study was young adults (18-30 years) which constituted 22.5% of the population. Infants were the least affected, making up only 1.45%. Other age groups include toddlers (12.1%), pre-school age (5.3%), school-aged (10.6%), adolescents (11.6%), middle-aged adults (18.8%) and old adults (17.9%) as shown in table 1 below.

In this study, 44.2% of the participants had discharge from the right ear, while 41.5% involved the left ear. Bilateral ear discharge was observed in 14.3% of the cases.

Table 1: Descriptive analysis of socio-demographic variables.

Variable	Frequency (n = 414)	Percentage (%)
Age (years)		
Infants (< 1year)	6	1.45
Toddlers (1-< 3 years)	50	12.1
Pre-school (3-5 years)	22	5.3
School-aged (6-11 years)	44	10.6
Adolescents (12-17years)	48	11.6
Young adults (18-30 years)	93	22.5
Middle-aged adults (31-45 years)	78	18.8
Old adults (>45 years)	73	17.6
Sex		
Females	212	51.21
Males	202	48.79

Organisms cultured included coliform (30.2%), *Pseudomonas species* (19.3%), *Staphylococcus aureus* 17.6%, *Proteus species* (2.4%), *Klebsiella species* (1.4%), *Streptococcus species* (1%), while 28% yielded no growth as shown in Figure 1 below.

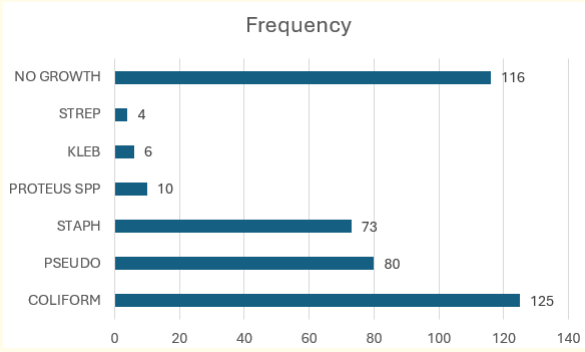

Figure 1: Microbial Isolates cultured from the Ear swabs. Key: Strep- Streptococcus Spp, Kleb- Klebsiella Spp, Staph- Staphilococcus aureus, pseudo- Pseudomonas aeruginosa.

The Antimicrobial sensitivity patterns of the isolated organisms from the ear swab samples are shown in the table below. Gentamycin (23.1%) has the highest activity against isolated micro-organisms, The least sensitive antibiotic was cefuroxime (0.29%). Others were Chloramphenicol (16.59%), Amoxicillin-clavulanic (13.4%), Ofloxacin (11.5%), Ciprofloxacin (9.89%), Cefixime (7.7%), Erythromycin (6.55%), Levofloxacin (6.4%), Streptomycin (3.93%) and Amoxicillin (0.5%).

	Coliform	*Klebsiella spp*	*Proteus spp*	*Pseudomonas aeruginosa*	*Staphilococcus aureus*	*Streptococcus spp*	NO GROWTH	Total
Amoxil	2	0	0	0	1	1	0	4 (0.5%)
Amoxicillin-clavulanic acid	32	1	2	11	43	3	0	92(13.4%)
Gentamicin	67	1	5	64	22	0	0	159(23.1%)
Ofloxacin	39	2	3	25	10	0	0	79 (11.5%)
Ciprofloxacin	34	1	3	16	13	1	0	68 (9.89%)
Erythromycin	19	1	1	3	20	1	0	45 (6.55%)
Levofloxacin	19	2	4	13	6	0	0	44 (6.4%)
Cefixime	18	1	5	7	21	1	0	53 (7.7%)
Streptomycin	12	2	0	9	4	0	0	27 (3.93%)
Cefuroxime	11	0	0	1	0	0	0	2 (0.29%)
Chloramphenicol	56	2	2	48	5	1	0	114(16.59%)

Table 2: Organisms cultured and the sensitivity pattern.

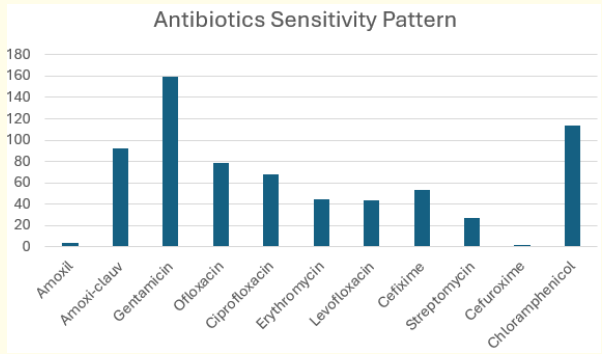

Figure 2: Antibiotics sensitivity pattern of the isolated organismsa.

Discussion

Chronic suppurative otitis media is a common otolaryngological disease. We recorded a prevalence of 11.8% compared to other cases managed at our clinic. Ologe., *et al.* recorded a prevalence of 73 per 1000 pupils in western Nigeria, which was approximately 7.3% [19]. A similar result was also recorded in Bangladesh and other parts of the world [11,13,20,21]. According to WHO, the disease is more prevalent in Africa and South-East Asia [22].

In our study, males were more commonly affected with a narrow ratio of 1:1.04 compared to females. This finding was similar to reports by Adebola., *et al.* and Olajide., *et al.* in western Nigeria [3,23]. Muluye., *et al.* in an independent study in Northwest Ethiopia however recorded a more significant male preponderance (63.7% vs 37.3%). This may be explained by the fact that males are thought to be more adventurous and thus more likely prone to risk factors for developing middle ear infections and ear discharge such as traumatic perforation of the tympanic membrane and upper respiratory tract infections. Infants were least affected in our study and the reason for this may be as a result of passive immunity acquired from mothers and also vaccination.

We recorded more unilateral ear involvement in 85.7% of the participants and bilateral ear involvement in 14.3%. Also, 44.2% was on the right, while 41.5% affected the left ear. Ologe., *et al.* recorded 79.5% of unilateral diseases in western Nigeria [19]. CSOM is most commonly unilateral except if the patient has underlying immunosuppression or a pathology causing mechanical obstruction to both eustachian tubes.

The most commonly isolated bacteria organisms were Gram-negative which included; *E. Coli* (30.2%), and *Pseudomonas aeruginosa* (19.3%). Other isolated Gram-negative organisms were *Proteus species* (2.4%) and *Klebsiella species* (1.4%). Gram-positive organisms isolated in our study included *Staphylococcus aureus* (17.6%) and *Streptococcus pneumoniae* (1%). Twenty-eight percent of the ear swab samples recorded no bacterial growth after incubation. Afolabi., *et al.* in a similar study in western Nigeria isolated more commonly *Pseudomonas aeruginosa* (31.3%), *Klebsiella species* (23.9%) and *Staphylococcus aureus* (16.4%). The least isolated organism in their study was *E. coli* (4.5%) in contrast to our findings [3]. Another study in Malawi found that *Proteus mirabilis, Pseudomonas aeruginosa,* and *Staphylococcus aureus* were the most prevalent aerobic bacteria, while *Bacteroides spp.* and *Peptostreptococcus spp.* were the commonest anaerobic bacteria causing CSOM [8].

The most sensitive antibiotic recorded in our study was Gentamicin (23.1%). Others were Chloramphenicol (16.59%), Amoxicillin-Clauvulanic acid (13.4%), Ofloxacin (11.5%), Ciprofloxacin (9.89%). The least sensitive were Cefuroxime (0.29%) and Amoxicillin (0.5%). An entirely different pattern was recorded by Afolabi., *et al.* where they discovered that Ciprofloxacin was shown to be the most effective, with high sensitivities for most of the isolated organisms. Several reports have indicated its efficacy, particularly against *Pseudomonas aeruginosa* and *Staphylococcus aureus* and thus recommended Ciprofloxacin as first-line drug treatment [24]. Oni., *et al.* recommended penicillins as the first line and quinolones as the second line [25]. A Few other studies however corroborated our findings [14,26]. Ototoxicity commonly associated with aminoglycosides has greatly limited its topical and systemic use in treatment of middle ear infections.

Ahmad *et al*. recorded 9.8% of their samples not isolating any organism [21]. The finding was in contrast to the 28% recorded in our study. The likely cause of this variation is due to the widespread use of over-the-counter topical and oral antibiotics by these patients before presentation to our clinic and before obtaining ear swab samples for microscopy, culture and sensitivity.

Various factors can contribute to the change in the pattern of bacterial causes of middle ear infections. One key explanation is that pneumococcal conjugate vaccinations (PCVs) are widely used in many countries. PCVs have been shown to reduce the occurrence of *Streptococcus pneumoniae*-associated otitis media. Changes in antibiotic prescribing practices have also aided in the shift in bacterial patterns. Antibiotic overuse and misuse have resulted in the creation of antibiotic-resistant bacterium strains. These resistant bacteria are increasingly being identified as the cause of middle ear infections. Variations in environmental and host factors may potentially contribute to variations in the bacterial patterns of middle ear infections.

Conclusion

From the observation in this study, it was concluded that the most prevalent organism implicated in chronic suppurative otitis media in our setting were *Escherichia coli* and *Pseudomonas aeruginos*a. Gentamicin was the most sensitive antibiotic in this study which contrasted with previous reports that recorded ciprofloxacin as the most sensitive antibiotic in the management of CSOM. Widespread antibiotic abuse and misuse which has been well documented as a risk factor for the development of antibiotic resistance and hence, treatment failures might have resulted in this change in sensitivity pattern. This is a serious threat to public health that must be addressed.

Acknowledgement

We specially acknowledge the management and staff of Eastern specialist Surgical clinics for their cooperation and assistance (non-financial) to see this study to fruition.

Conflict of Interest

Nil.

Bibliography

1. Khan JA., *et al*. "Bacteriology of Chronic Supporative Otitis Media (CSOM) at a Tertiary Care Hospital, Mymensingh". *Mymensingh Medical Journal* 29.3 (2020): 545-552.

2. Brook I. "The role of anaerobic bacteria in chronic suppurative otitis media in children: implications for medical therapy". *Anaerobe* 14.6 (2008): 297-300.

3. Olajide TG., *et al*. "Bacteriological agents of chronic discharging ears and their antibiotic sensitivity pattern in Ido - Ekiti, Nigeria". *Nigerian Postgraduate Medical Journal* 19.1 (2012): 30-35.

4. Hiremath B., *et al*. "Bacteriological Profile and Antimicrobial Susceptibility Pattern in Chronic Suppurative Otitis Media: A 1-Year Cross-Sectional Study". *Indian Journal of Otolaryngology and Head and Neck Surgery* 71 (2019): 1221-1226.

5. Uddén F., *et al*. "Aerobic bacteria associated with chronic suppurative otitis media in Angola". *Infectious Diseases of Poverty* 7.1 (2018): 42.

6. Iseh K and Abubakar T. "Chronic Suppurative Otitis Media: A Clinical Profile in Sokoto, Nigeria". *Sahel Medical Journal* 6 (2004).

7. Xu J., *et al*. "Bacteriological Profile of Chronic Suppurative Otitis Media and Antibiotic Susceptibility in a Tertiary Care Hospital in Shanghai, China". *Ear, Nose and Throat Journal* 100.9 (2021): NP391-NP396.

8. Chirwa M, et al. "Microbiology of chronic suppurative otitis media at Queen Elizabeth Central Hospital, Blantyre, Malawi: A cross-sectional descriptive study". *Malawi Medical Journal* 27.4 (2015): 120-124.

9. Mittal R., *et al*. "Current concepts in the pathogenesis and treatment of chronic suppurative otitis media". *Journal of Medical Microbiology* 64.10 (2015): 1103-1116.

10. Wan Draman WNA., *et al*. "Evaluation of the current bacteriological profile and antibiotic sensitivity pattern in chronic suppurative otitis media". *Laryngoscope Investigation Otolaryngology* 6.6 (2021): 1300-1306.

11. Muluye D., *et al*. "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 Disorder* 13.1 (2013): 10.

12. Tesfa T., *et al*. "Bacterial otitis media in sub-Saharan Africa: a systematic review and meta-analysis". *BMC Infectious Disorder* 20.1 (2020): 225.

13. Kombade SP., *et al*. "Clinico-bacteriological and antibiotic drug resistance profile of chronic suppurative otitis media at a tertiary care hospital in Western Rajasthan". *Journal of Family Medicine and Primary Care* 10.7 (2021): 2572-2579.

14. Brook I and Yocum P. "Quantitative bacterial cultures and beta-lactamase activity in chronic suppurative otitis media". *Annals of Otology, Rhinology and Laryngology* 98.4 (1989): 293-297.

15. Aduda DSO., *et al*. "Bacteriology of chronic suppurative otitis media (CSOM) in children in Garissa district, Kenya: a point prevalence study". *International Journal of Pediatric Otorhinolaryngology* 77.7 (2013): 1107-1111.

16. Getaneh A., *et al*. "Bacterial Etiologies of Ear Infection and Their Antimicrobial Susceptibility Pattern at the University of Gondar Comprehensive Specialized Hospital, Gondar, Northwest Ethiopia: A Six-Year Retrospective Study". *Infection and Drug Resistance* 14 (2021): 4313-4322.

17. Aliyu I., *et al*. "Bacteriology of otitis media and its host-environmental-infection factors". 3 (2017): 20-27.

18. Weinstein MP and Lewis JS. "The Clinical and Laboratory Standards Institute Subcommittee on Antimicrobial Susceptibility Testing: Background, Organization, Functions, and Processes". 58 (2020).

19. Ologe FE and Nwawolo CC. "Prevalence of chronic suppurative otitis media (CSOM) among school children in a rural community in Nigeria". *Nigerian Postgraduate Medical Journal* 9.2 (2002): 63-66.

20. Kamal N., *et al*. "Prevalence of chronic suppurative otitis media among the children living in two selected slums of Dhaka City". *Bangladesh Medical Research Council Bulletin* 30.3 (200): 95-104.

21. Ahmad S. "Antibiotics in chronic suppurative otitis media : A bacteriologic study". (2013): 191-194.

22. Acuin J. "Chronic suppurative otitis media". *Clinical Evidence (Online)* 12 (2004): 710-729.

23. Adebola SO., *et al*. "Profile of anaerobic bacteriology of middle ear aspirates in a developing country: does immunocompromise play a role?" *Anaerobe* 26 (2014): 31-35.

24. Oa A., *et al*. "Pattern of bacterial isolates in the middle ear discharge of patients with chronic suppurative otitis media in a tertiary hospital in North central Nigeria". 12.3 (2012).

25. Oni AA., *et al*. "Bacterial agents of discharging ears and antimicrobial sensitivity patterns in children in Ibadan, Nigeria". *West African Journal of Medicine* 20.2 (2001): 131-135.

26. Ibekwe AO., *et al*. "Anaerobes and fungi in chronic suppurative otitis media". *Annals of Otology, Rhinology and Laryngology* 106.8 (1997): 649-652.