PREVALENCE AND ANTIMICROBIAL SENSITIVITY PATTERN OF PSEUDOMONAS AERUGINOSA FROM CHRONIC SUPPURATIVE OTITIS MEDIA (CSOM) CASES IN A TERTIARY CARE HOSPITAL OF BIHAR

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ABSTRACT

BACKGROUND

Among the bacteria causing CSOM, *Pseudomonas aeruginosa* has been particularly blamed for the deep-seated and progressive destruction of middle ear and mastoid structures through its toxins and enzymes.

Objective- To study the prevalence and antimicrobial sensitivity pattern of *P. aeruginosa* in CSOM cases.

MATERIALS AND METHODS

This study was conducted over a time period of one and a half years. *Pseudomonas aeruginosa* isolates from ear discharge specimens of clinically diagnosed cases of CSOM were identified and confirmed by standard methods. Antimicrobial sensitivity testing of the isolates was done by Kirby-Bauer disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

RESULTS

All the 42 (100%) isolates were sensitive to fluoroquinolone group of antibiotics whereas cephalosporin was the second most effective group, which showed 97% sensitivity. It was followed by Aminoglycosides (60%), Ampicillin (23%), Macrolides (22%) and Amoxicillin/clavulanic acid (15%).

CONCLUSION

Overall the most sensitive antibiotic groups were fluoroquinolones and cephalosporins and least effective were penicillins and macrolides. Antimicrobial stewardship should be practised to prevent MDR cases. The infection control measure should be followed properly.

KEYWORDS

Pseudomonas Aeruginosa, Antibiotic Sensitivity Pattern, CSOM.

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BACKGROUND

Chronic suppurative otitis media (CSOM) is a source of tremendous health predicament since time immemorial and till date it produces immense intricacy both for patients and medical practitioners in general and an otologist in particular. It is a long-standing inflammation of the mucoperiosteum of the middle ear cleft leading to offensive ear discharge and hearing impairment that may have a serious long-term effect on language, auditory, and cognitive development and educational progress. It may be indolent for long time or endanger the life of the patient depending upon the type of pathological process, virulence of organism and the inner build of the individuals.^[1]

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In CSOM, bacteria can reach the middle ear from the nasopharynx through the Eustachian tube or from the External Auditory Canal (EAC) via a perforated tympanic membrane. Various studies have shown that both Gram-positive and Gram-negative organisms are responsible for infection of middle ear, Gram-negative ones outnumbering the Gram-positive. The incidence of single to mixed infection is in the ratio of 4.7:1.^[2] The most common organisms associated with CSOM are *Staphylococcus aureus* and *Pseudomonas* spp. Others include *Proteus*, *E. coli*, *Klebsiella*, *Enterobacter*, non-fermenting Gram-negative bacteria and beta haemolytic *Streptococcus*. It is revealed that there is no significant difference in bacterial finding in children and adult.^[2]

The role of anaerobes in CSOM is often questioned. They are mostly detected in cases with extensive cholesteatoma or granulation tissue. Fungal infection of the middle ear and meatus are common as fungi thrive well in moist pus. The most commonly seen fungi are *Candida* and *Aspergillus*. Development of otalgia, itching and presence of hyphae indicate fungal involvement.^[3] The basic principles the medical management of CSOM are aural toilet and the installation of a topical antimicrobial agent. While eradicating a specific organism from a chronically discharging ear will

reduce the sensitivity of symptoms, it will in case of safe perforation render the ear quiescent. Streptococci respond to oral penicillin, while Haemophilus influenza responds rapidly to oral Amoxicillin or Trimethoprim. Oral Erythromycin or Flucloxacillin may eliminate Staphylococcus aureus. Beta lactamase producing organisms have been identified in 63% of 175 positive cultures from chronic ears, many of which have been previously treated with antibiotics from the penicillin group. The ability to produce beta lactamase renders them resistant to the semi synthetic penicillin. Proteus, Klebsiella and E. coli are sensitive to oral antibiotics, but fall in to this group. Fourth generation Cephalosporins and Fluoroquinolones, particularly Ciprofloxacin, have given us oral anti-pseudomonals for the first time. They are immensely useful; however, resistant strains are already emerging. Topical antibiotics reach organisms in debris and in mucus more quickly and in greater concentration than oral antibiotics.^[4]

MATERIALS AND METHODS

The study was conducted on 150 patients in the Department of Microbiology, over a period of 18 months from March 2013 to August 2014. The patients attending the ENT Department with more than 3 months history of ear discharge and central perforation, and clinically diagnosed as tubotympanic type of CSOM were included in this study. Each of these patients was subjected to complete history pertaining to name, age, sex, occupation, socioeconomic status, rural and urban distribution, laterality, symptoms like ear discharge, hearing loss, tinnitus, vertigo, itching, otalgia, character of discharge and duration of discharge. Thorough ENT examination was done for each case by otoscopy and PTA (Pure tone audiometry). Radiological and microbiological investigations were also done.

Inclusion Criteria

Patients diagnosed with active tubotympanic type of chronic suppurative otitis media of more than 6 years of age.

Exclusion Criteria

- Inactive stage of tubotympanic type of CSOM.
- Atticoantral type of CSOM.
- Otitis externa.
- Current antibiotic use or use in preceding five days (topical and systemic).
- Malignancy of middle ear treatment.
- Previous history of surgery.

Two sterile cotton swabs were used to collect ear discharge from CSOM patients. Only those cases were selected who had not taken any treatment either systemic or local in the form of ear drops for the last seven days. One swab was used for performing Gram stain and KOH preparation and second one for culture. Culture was done on nutrient agar, blood agar, MacConkey agar and SDA. The organisms were identified by culture characters, morphology, and pigment production, beta-haemolysis on blood agar, motility and conventional biochemical tests. Antimicrobial susceptibility test for all isolates was performed on Mueller-Hinton agar plate using Kirby-Bauer disc diffusion methods. Antibiotic discs were procured from HiMedia Labs Mumbai Result were interpreted using Clinical Laboratory Standards Institute (CLSI) guidelines.

Statistical Analysis

The data collection was entered in the Microsoft Excel computer program using SPSS version 16.0, and checked for any discrepancy. The result was presented in proportion/percentages.

Ethical Consideration

Ethical clearance was taken from Institutional Ethical Committee.

RESULTS

A total of 152 swabs were collected from 150 cases and sent for culture sensitivity. Out of those, 30 (19.7%) were sterile while 122 swabs yielded growth of organisms. Gram staining of the 152 swabs showed predominance of Gram-negative organisms with Gram-negative bacilli in 41.4% ears. Out of 152 swabs, 4 (3.3%) yielded polymicrobial organisms, while 115 (96.6%) yielded monomicrobial flora. In three swabs, fungal growth was seen. Among the monomicrobial isolates, Pseudomonas aeruginosa was the commonest offender seen in 42 (36.5%) swabs, followed by Staphylococcus aureus in 34 (29.5%) ears. Polymicrobial isolation was associated with Pseudomonas spp. and Staphylococcus aureus. Age range was from 6 to 70 years, with a mean age of 27.17 years with S.D. $\pm$ 16.8. Maximum numbers of cases were found to be in the second or third decade with 35 (23.3%) cases each in 11-20 and 21-30 years age group. There was a male preponderance with a male to female ratio of 1.3:1. Maximum number of cases were from lower middle socioeconomic class (36.6%). Most of the cases (53.3%) presented with left ear involvement. All of the Pseudomonal species were sensitive to Fluoroquinolones group of antibiotics. Cephalosporins were the second most effective group, showing 97% sensitivity followed by Aminoglycosides (60%), Ampicillin (23%), Macrolides (22%) and Amoxicillin/clavulanic acid (15%). Most sensitive antibiotic groups were Fluoroquinolones and Cephalosporins and least effective were Penicillins and Macrolides.

Gram Stain	Isolate	Number	Percentage
Gram negative (n=63)	Pseudomonas spp.	42	36.5%
	Proteus spp.	13	11.3%
	E. coli	4	3.4%
	Citrobacter	4	3.4%
Gram positive (n=52)	Staphylococcus aureus	34	29.5%
	Coagulase-negative Staph	18	15.6%

Table 1. Microorganism Isolated in Positive Culture

Pseudomonas Species				
Antibiotic	Indudharan et al.	Ayson et al.	Poorey & Aiyer	Present Study
Ampicillin	2.4%	35.7%	66.6%	23%
Amoxicillin/clavulanic acid	-	-	-	15%
Macrolides	-	22.2%	-	22%
Aminoglycosides	-	83.3%	75.4%	60%
Cephalosporins	100%	-	76.4%	97%
Fluoro-quinolones	98.9%	85.7%	81.3%	100%

Table 2. Antibigram of Pseudomonas spp.

DISCUSSION

In CSOM, bacteria can reach the middle ear from the nasopharynx through the Eustachian tube or from the external auditory canal (EAC) via a perforated tympanic membrane. Untreated cases of CSOM can result in broad range of complications.

In the present study, age of the patient ranged from 6 to 70 years. The mean age was 27.17 years with standard deviation of ± 16.8 . The commonest age group of presentation was 11-20 and 21-30 years, consisting 35 (23.3%) cases in each category. These findings were consistent with the findings of Shreshtha & Sinha⁵ and Singh & Safaya⁶. However, a much earlier presentation was reported by Rupa V et al⁷ and Vikram BK et al.⁸ They concluded that the disease was more frequently seen in children because of immature immunity and supplementary upper respiratory tract contagion. The basis for delayed presentation in our study may be due to recklessness of the patients to seek consideration about their health. They only think about the necessity of the medical contemplation once they accomplish the age of nuptials or employment.

The present study showed that CSOM was diagnosed in males (58%) as compared to females (42%). The ratio of male to female patients was 1.3:1. Analogous conclusion has been made by Chandra & Mishra⁹, Mukherjee P et al and Hossain MM et al.¹⁰ They concluded that the predominant burden of the disease in males was due to their outdoor working habits exposing them for contamination and contagion. Wang HM et al¹¹ De Vos C et al¹² and reported a female preponderance in their study with the prevalence of 57.9% and 57% respectively. They elucidated that the females in hilly locale accomplish the majority of the outdoor exertion, and hence, are more exposed to the climate and atmospheric changes. The indiscriminate attitude of the society towards females prevents them from proper medical education and amenities making them vulnerable for recurrent middle ear infection.

In the present study, unilateral aural involvement was seen in 98.6% cases, of which, left and right ear were involved in 53.3% and 45.3% respectively. Bilateral ear involvement was only seen in 1.3% patients.

Comparable results were obtained in the study of Kamal N et al¹³ and Olusesi AD¹⁴ with similar predominance of left ear. In contrast, Gulati SP et al observed right side involvement in 51.5% cases. Majority of the studies concluded that TT of CSOM predominantly involved right side, as the deviated nasal septum is more common on right side and moreover, skull is tilted to 15° on the right side. Our findings are not in accordance with these studies. The scrutiny of the cause of left side predominance needs further evaluation which was beyond the scope of present study.

In the aerobic culture, the commonest organism isolated was *Pseudomonas* species in 46 (38.6%) ears. Bairy I et al also found *Pseudomonas aeruginosa* (33.9%) as the commonest organism. Similarly, Poorey & Iyer¹⁵ isolated *Pseudomonas* in 35.2% ears. *Pseudomonas* was also isolated as the predominant organism by Maji PK et al¹⁶ (63.8%), Kumar S et al¹⁷ (45.9%) and Indudharan R et al¹⁸ (27.2%).

The occurrence of *Pseudomonas aeruginosa* as the prime offender can be attributed to various factors. *Pseudomonas*, survives competition with other pathogens due to its minimal nutritional requirement and its armamentarium of

antibacterial products, pyocyanin and bacteriocin. Vartiainen & Vartiainen¹⁹ postulated that *Pseudomonas* has the ability to carve out a niche for itself in local infection through the necrotising activities of its extracellular enzymes. The physical characteristics of the niche, damaged epithelium, interrupted circulation and devitalised tissue protects the organism from normal host defence mechanisms and antibiotic agents. In addition, the organism acts as an opportunistic pathogen, flourishes in external auditory canal and may cause suppurative disease in contiguous sites. *Staphylococcus aureus* 38 (31.9%) was the second most common pathogen isolated in the present study. Similar number of isolation has been reported by Kukreja SM et al²⁰ (33.9%), Freidmann I²¹ (32.1%), Nikakhlagh S et al²² (32.4%) and Ettehad G et al²³ (31.1%). However, *Staphylococcus aureus* was reported as the commonest pathogen by Pajor A et al,²⁴ Ayson AN et al,²⁵ and Gupta V et al²⁶ in their respective studies. They explained that the high incidence of *Staphylococcus aureus* in CSOM could be attributed to its ubiquitous nature and high carriage in the external auditory canal and upper respiratory tract.

Microbial sensitivity of *Pseudomonas* revealed that all the isolates were sensitive to Fluoroquinolones, while, 97% were sensitive to the cephalosporin group and 60% to aminoglycosides. Only 23%, 22% and 15% were sensitive to Ampicillin, Macrolides and Amoxicillin-clavulanic acid respectively. Similar data were obtained by Akhtar N et al²⁷ in which most of the *Pseudomonas* isolates showed more than 90% sensitivity to Fluoroquinolones, followed by Cephalosporin and Aminoglycosides. Majority were found to be resistant to Penicillins and Macrolides. Indudharan R et al also obtained identical results in their study. They observed that the sensitivity was 100% to Cephalosporin, 98.9% to Fluoroquinolones while the organism was almost resistant to Penicillin (97.6%). The result of present study was in accordance to Loy AH et al.²⁸ They observed that *Pseudomonas aeruginosa* showed 90% sensitivity to Cephalosporins, Fluoroquinolones, anti-*Pseudomonas* Penicillins and Aminoglycosides. Ettehad G et al also found high sensitivity rates for Fluoroquinolones (85.7%) and nearly 100% resistance to Ampicillin. Bairy I et al²⁹ also concluded that Ampicillin (1.5%) and Amoxicillin/clavulanic acid (6.3%) were the least effective antibiotics. Data from Ayson AN et al study showed 64.3% resistance to Penicillins while Fluoroquinolones were active against 85.7% isolates followed by Amikacin (83.3%).

However, some results have shown a much lower sensitivity pattern for Fluoroquinolones. Kumar S et al³⁰ reported only 63.2% sensitivity for Ofloxacin and 59.6% sensitivity for Ciprofloxacin. Similarly, Maji PK et al showed 46.6% sensitivity rate of Ciprofloxacin. The decreased sensitivity of *Pseudomonas* to the quinolone family, to which it was highly sensitive until recently, is indicative of the rapid appearance of antibiotic-resistant strains of *Pseudomonas* which is a matter of great concern.

CONCLUSION

The indiscriminate and haphazard use of antibiotics and poor followup of these patients has resulted in the emergence of multiple resistant strains of bacteria and the persistence of low-grade infection. Changes in the microbiological flora following the advent of sophisticated synthetic antibiotics

increase the relevance of reappraisal of the modern-day flora in CSOM. Knowledge of the prevailing flora and their susceptibility to antimicrobials will guide the clinician in prescribing an empirical regimen so that a better and more specific management can be provided to the patients. Hence, this study is relevant in the present scenario.

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