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Prevalence and antibiotic susceptibility of *Pseudomonas aeruginosa* isolated from chronic suppurative otitis media

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ABSTRACT

Background: Chronic suppurative otitis media (CSOM) is the most common middle ear infection characterized by recurrent ear discharges or otorrhoea through a tympanic perforation from the middle ear. The organisms isolated from CSOM include both aerobic and anaerobic bacteria. Among the bacteria, *Pseudomonas aeruginosa* (*P. aeruginosa*) has been particularly blamed for deep seated and progressive destruction of middle ear and mastoid structures through its toxins and enzymes. The present study was done to determine the prevalence and antibiotic susceptibility of *P. aeruginosa* isolated from CSOM.

Methods: This was a retrospective study conducted in a tertiary care hospital in South India in March 2016. Data was obtained from the microbiology records from January 2014 to January 2016. Patients who had active ear discharge for at least three months were included in the study. *P. aeruginosa* was identified by colony morphology, pigment production, characteristic musty or earthy odor. The identification was confirmed by motility and standard biochemical tests.

Results: A total of 293 cases of CSOM were included in the study. Microbial growth was seen in 248 (84.6%) cases and remaining 45 cases did not show any growth. Among 248 bacterial growth, 87 (35%) were positive for P. aeruginosa. Most common organism was *P. aeruginosa* followed by *Staphylococcus aureus*. Highest resistance was seen with Gentamicin and Ofloxacin and least resistance with Imipenem. The increased resistance to Cephalosporin group is warning sign, as these are potent anti-Psuedomals.

Conclusions: *P. aeruginosa* and Staphylococcus aureus were found to be the common cause of CSOM in the present study. *P. aeruginosa* was resistant to commonly used antimicrobials. There was no resistance seen with Imipenem and only two strains were resistant to Piperacillin+tazobactum. Regular evaluation of the microbiological pattern and antibiogram of isolates will help in decreasing the complications of CSOM.

Keywords: Otitis media, P. aeruginosa, Antibiogram, Resistance

INTRODUCTION

Chronic suppurative otitis media (CSOM) is the most common middle ear infection characterized by recurrent ear discharges or otorrhoea through a tympanic perforation from the middle ear. In developed countries the incidence of CSOM has decrease but is higher in developing countries attributed to various factors like because of malnutrition, low socioeconomic society, poor personal hygiene, recurrent upper respiratory tract infection and lack of adequate primary health care

facilities.²⁻⁴ Inadequate treatment of CSOM may lead to serious intra-cranial and extra-cranial complications like facial nerve paralysis, meningitis, mastoid abscess, deafness, lateral sinus thrombosis and intracranial abscess.⁵

Although the complication are less common now due to availability of broad spectrum antibiotics, the resistance of the causative organisms is very common.⁶ The organisms isolated from CSOM include both aerobic (e.g. *Pseudomonas aeruginosa*) and anaerobic bacteria (e.g.

Bacteroids, Peptostreptococcus) and fungi (e.g. *Candida, Aspergillus*).⁷ The bacterial resistance in CSOM is associated with both topical and systemic antibiotics.⁸ Indiscriminate use of antibiotics has resulted in the emergence of multiple resistant strains of bacteria and the persistence of low-grade infections.^{9,10}

Among the bacteria, *Pseudomonas aeruginosa* (*P. aeruginosa*) has been particularly blamed for deep seated and progressive destruction of middle ear and mastoid structures through its toxins and enzymes. ¹¹ The prevalence and susceptibility pattern of the organisms has been reported to vary with time and geographical area, probably due to indiscriminate use of the antibiotics. ¹² Knowledge of the local microbiological profile of CSOM and their resistance pattern is essential for empirical therapy. Hence the present study was done to determine the prevalence and antibiotic susceptibility of *P. aeruginosa* isolated from CSOM.

METHODS

This was a retrospective study conducted in a tertiary care hospital in South India in March 2016. Data was obtained from the microbiology records from January 2014 to January 2016. Patients who had active ear discharge for at least three months were included in the study. Patients, who had otomycosis or malignancy in the ear, were excluded. The ear discharge was collected with two cotton swabs under strict aseptic precautions with an aural speculum and not who have not taken any treatment either systemic or topical treatment for the last seven days. The first swab was used for direct Gram stain and the second swab was cultured in nutrient agar, blood agar and Mac-conkey agar plates incubated at 37°C for 24-48 hours. P. aeruginosa was identified by colony morphology, pigment production, characteristic musty or earthy odor. 13 The identification was confirmed by motility and standard biochemical tests.14

Antimicrobial susceptibility testing was done by Kirby-Bauer's disc diffusion method and the results were interpreted according to the guidelines of Clinical and Laboratory Standards Institute (CLSI) 2012. 15 The following anti-microbials were used, Piperacillin (100 Piperacillin+Tazobactum (100/10mcg), Cefoperazone+Sulbactum (75/10 mcg), Gentamicin (10 mcg), Amikacin (30 mcg), Ofloxacin (5 mcg), Ceftriaxone (30 mcg), Ceftazidime (30 mcg), Aztreonam (30 mcg), Imipenem (10 mcg) and Azithromycin (15mcg) (Hi Media, Mumbai). P. aeruginosa ATCC 27853 was used as the control strain. The information was recorded and analyzed using Microsoft Excel (2010 version) and the results are explained in frequency and percentage.

RESULTS

A total of 293 cases of CSOM were included in the study. Microbial growth was seen in 248 (84.6%) cases and

remaining 45 cases did not show any growth. Among 248 bacterial growth, 87 (35%) were positive for *P. aeruginosa*. The other organisms isolated are shown in Table 1. Most common organism was *P. aeruginosa* followed by *S. aureus*.

The age and gender distribution of *P. aeruginosa* isolated cases is shown in Table 2.Maximum cases were from males and in the age group of 11-20 years.

The site of distribution of *P. aeruginosa* cases and the degree of hearing loss is shown in Table 3. Right ear was the most common affected and the degree of hearing loss was moderate in 41.35 of the cases.

The antibiotic sensitivity pattern of *P. aeruginosa* is shown in Table 4. Highest resistance was seen with Gentamicin and Ofloxacin and least resistance with Imipenem.

Table 1: Microorganisms isolated in positive cultures.

| Organism | Frequency | Percentage |
|--------------------------------------|-----------|------------|
| Aerobic bacteria | | |
| Pseudomonas aeruginosa | 87 | 35 |
| Staphylococcus aureus | 51 | 20.5 |
| Coagulase negative Staphylococcus | 27 | 10.8 |
| Klebsiella pneumoniae | 21 | 8.4 |
| Streptococcus pneumoniae | 14 | 5.6 |
| Escherichia coli | 09 | 3.6 |
| Proteus mirabilis | 10 | 4 |
| Anaerobes | | |
| Bacteroids species | 11 | 4.4 |
| Peptostreptococcus species | 9 | 3.6 |
| Fusobacterium | 5 | 2 |
| Fungi | | |
| Candida sps | 4 | 1.6 |
| Total | 248 | 100 |

Table 2: Age and gender distribution of *P. aeruginosa* isolated cases (n=87).

| Age group (Years) | Male | Female | Total |
|-------------------|------|--------|-------|
| 0-10 | 3 | 3 | 6 |
| 11-20 | 21 | 10 | 31 |
| 21-30 | 9 | 5 | 14 |
| 31-40 | 14 | 8 | 22 |
| 41-50 | 3 | 4 | 7 |
| 51-60 | 2 | 2 | 4 |
| 61-70 | 2 | 1 | 3 |
| Total | 54 | 33 | 47 |

Table 3: The side of distribution of *P. aeruginosa* cases and the degree of hearing loss (n=87).

| Side of ear discharge | Number | Percentage |
|-----------------------|--------|------------|
| Left ear | 31 | 35.6 |
| Right ear | 42 | 48.2 |
| Bilateral | 14 | 16 |
| Degree of hearing los | s | |
| Mild (26 -40db) | 27 | 31 |
| Moderate (41-55db) | 36 | 41.3 |
| Severe (56-91db) | 09 | 10.3 |
| Profound (91 db) | 05 | 5.7 |

Table 4: Resistance pattern of *P. aeruginosa* (n=87).

| Antibiotics | Frequency | Percentage |
|-----------------------------|-----------|------------|
| Piperacillin | 29 | 33.3 |
| Piperacillin+ Tazobactum | 2 | 2.2 |
| Cefoperazone+ Sulbactum | 9 | 10.3 |
| Gentamicin | 41 | 47.1 |
| Amikacin | 36 | 41.3 |
| Ofloxacin | 38 | 43.6 |
| Ceftriaxone | 31 | 35.6 |
| Ceftazidime | 26 | 298 |
| Aztreonam | 9 | 10.3 |
| Imipenem | 0 | 0 |
| Azithromycin | 22 | 25.2 |

DISCUSSION

Chronic suppurative otitis media is a major health problem having high prevalence in developing countries like India. CSOM if not adequately treated may lead to fatal intra-cranial and extra-cranial complications like facial palsy, brain abscess, meningitis etc. ¹⁶ Early diagnosis, knowledge of regional etiological microbes and an effective antibiotic policy can avoid these complications. Although wide variety of antimicrobial agents with antipseudomonal activities are available, life threatening infections caused by *P. aeruginosa* continue to be prevalent. ¹⁶⁻¹⁹

In the present study, prevalence of *P. aeruginosa* in CSOM cases was 35%. *P. aeruginosa* was the most common isolate followed by *S. aureus*. This finding is similar to other studies which have reported *P. aeruginosa* as the most common isolate ranging from 21% to 54%, but some studies have reported *S. aureus* as the most common isolate. ²⁰⁻²⁴ This difference might be due to geographical variation and local anti-biogram pattern. The other bacteria and fungi isolated are shown in Table 1. The findings of the present study are in accordance with pattern of CSOM infection within the tropical region. It was observed that both gram positive and gram negative microbes are responsible for infection.

In the present study, prevalence of *P. aeruginosa* infection was more in males as reported by other studies but some studies have found female preponderance. ^{20,21,24,25} In our study, the peak incidence was found in the age group between 11-20 years. This was in concordance with other studies which showed that peak incidence was occurring in infants and young children. ^{22,25} Children are more prone for development CSOM because of Eustachian tubes are shorter, horizontal than adults and are made up of more flaccid cartilage which causes impaired opening of the tube. Right ear was most commonly affected as found in other studies. ^{22,24}

The resistance pattern of *P. aeruginosa* is shown in Table 4. Highest resistance was seen with Gentamicin and Ofloxacin and least resistance with Imipenem. Among the β-lactamase inhibitor antibiotics, Piperacillin showed 33% resistance, but when combined with tazobactum, the resistance decreased to 2%. This finding is in agreement with the recent study which recommended the use of Piperacillin plus Tazobactem like combinations against *P. aeruginosa* infections. ²⁶ Among the Aminoglycosides, least resistance was seen with Amikacin. This finding is in agreement with other studies. ²⁷⁻²⁹

The increased resistance to Cephalosporin group is warning sign, as these are potent anti-Psuedomals. Some studies have reported good sensitivity to carbapenems while other studies have reported a higher incidence of carbepenem resistance. ²¹⁻²⁴ This difference might be due to restricted use of Imipenem in our hospital and varying demographics of the patients and local hospital factors Some strains were resistant to Aztreonam and combination of Cefoperazone+sulbactum.

Increasing resistance to different anti-Pseudomonal drugs particularly among hospital strains, has been reported world-wide. P. aeruginosa is inherently resistant to many antimicrobial agents, mainly due to the synergy between multi-drug efflux system or a type1 AmpC β -lactamase and low outer membrane permeability. $^{30\text{-}32}$

Antibiogram studies should be done regularly to know the current susceptibility patterns in local hospitals. In most of the hospitals, sensitivity reports are not readily available, often empirical therapy is needed. Regional antibiotic susceptibility studies will help in choosing an appropriate antibiotic for empirical therapy. Regular antibiogram studies will help in developing an hospital antibiotic policy which in turn will help in promote rational use of antibiotics and prevent emergence of resistance.

Limitations of the study

The present study was conducted in a single centre and the sample size was small. Future studies should be multi-centric and include a large sample size.

CONCLUSION

P. aeruginosa and S. aureus were found to be the common cause of CSOM in the present study. P. aeruginosa was resistant to commonly used antimicrobials. There was no resistance seen with Imipenem and only two strains were resistant to Piperacillin+tazobactum. Regular evaluation of the microbiological pattern and antibiogram of isolates will help in decreasing the complications of CSOM. An effective national and state level antibiotic policy should be framed for preserving the effectiveness of antibiotics and prevent the emergence of resistance.

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Institutional Ethics Committee

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