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Original Research Article

Bacteriology of acute otitis externa in a tertiary care centre

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ABSTRACT

Background: Acute otitis externa is a common bacterial infection of the external auditory canal, often associated with swimming or minor trauma. Understanding the bacterial communities and their antibiotic susceptibility patterns is crucial for effective treatment.
Methods: This hospital-based prospective observational study included 111 patients with acute otitis externa. Aural swabs were collected, and bacterial isolates were identified through gram staining and culture and sensitivity testing.
Results: The most common age group affected was 46-55 years, with a female predominance (56.76%). The most prevalent symptoms were ear pain (100%), swelling in the external auditory canal (85.58%), and otorrhea (78.37%). Gram-negative organisms (53.15%) were more common than gram-positive organisms (46.85%). *Pseudomonas aeruginosa* (44.82%) and *Staphylococcus aureus* (39.09%) were the most frequently isolated bacteria. Antibiotic susceptibility testing revealed that these organisms were susceptible to various antibiotics, including piperacillin/tazobactum, aztreonam, tobramycin, and ciprofloxacin.
Conclusions: This study highlights the importance of understanding the bacterial communities and their antibiotic susceptibility patterns in acute otitis externa. *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the most common isolates, and targeted antibiotic therapy can effectively treat aural infections.

Keywords: Acute otitis externa, Antibiotic susceptibility, *Pseudomonas aeruginosa*, *Staphylococcus aureus*

INTRODUCTION

Acute diffuse otitis externa called as swimmer's ear refers to bacterial infection and inflammation of the skin and subcutaneous tissue of the cartilaginous EAC.[1] Acute otitis externa presents with the rapid onset of ear canal inflammation, resulting in otalgia, itching, canal edema, canal erythema, and otorrhea, and often occurs following swimming or minor trauma from inappropriate cleaning. Characteristic symptoms are itching, pain, and tenderness of the pinna with associated hearing loss and aural fullness. Examination typically reveals erythema and edema of the external auditory canal skin, which may spread to involve the concha and lobule. Seropurulent otorrhea often results in crusting of the EAC and concha. Manipulation of the pinna and mastication generally elicit pain. In advanced cases, worsening edema significantly narrows the external canal lumen, preventing visualization of the tympanic membrane, and associated inflammatory changes may spread to involve preauricular soft tissue.[2] Bacterial infection is the most frequent cause of acute otitis externa. *Pseudomonas aeruginosa* and other Gram-negative bacteria, including *Escherichia coli*, *Proteus mirabilis*, and *Staphylococcus aureus*, are the commonly isolated organisms. Additionally, as part of the natural flora of the external auditory canal, *S. aureus* and *Streptococcus viridans* are also present. In ear canal, waste products absorb water when there is less cerumen, creating an ideal environment for bacterial development. As a result, different bacteria can be observed in the ear canal.[3]

Microbiology of otitis externa includes, 1) Bacteria *Pseudomonas* spp.-50-65%, 2) Other gram-negative organisms-25-35%, 3) *Staphylococcus aureus*-15-30%, 4) *Streptococcus* spp.-9-15%.

This study aimed to study difference in distribution of bacterial communities in acute otitis externa.

METHODS

Study type

A hospital based prospective observational study of 120 cases of acute otitis externa, out of which 111 patients met the inclusion criteria.

Study place

This study was conducted at Department of Otorhinolaryngology Assam Medical College and Hospital, Dibrugarh, Assam, India.

Study period

This study was conducted from November 2023 to October 2024.

Inclusion criteria

All patients presenting with acute onset ear ache (<48 hours) and the clinically diagnosed as acute otitis externa were included after obtaining written informed consent.

Exclusion criteria

Patients who have not given the consent and on antibiotics therapy for their ear complaints were excluded from the study.

After conducting ear examination of the patient, aural swabs were obtained from ear using a special ear speculum suction curette or a sterile loop. Aural swab reports collected of patients with acute otitis externa after obtaining their informed consent. Correlation between the relative prevalence of a potential pathogens were examined. Bacterial colonies were identified on basis of Gram-staining results, shape of the bacteria, and the relevant diagnostic test results.

The study was approved by the Institutional Ethics Committee.

Statistical analysis

Statistical Product and Service Solutions (SPSS) 20.0 software (SPSS, Chicago, Illinois, USA) and Microsoft Excel 2010 were used for computer-based analysis after data was tabulated in a Microsoft Excel worksheet.

RESULTS

A total of 111 patients of acute otitis externa were identified. Most common age range of patients in our study was 46-55 years. Upon direct evaluation of the samples, 111 people tested positive for the bacterial presence in gram staining but only 87 cases reported with bacterial growth in culture and sensitivity testing. The age group most impacted was 46-55 years old (33.33%), whereas the age group least affected was under 15 years old (Table 1).

Figure 1: Edematous ear pinna and inflammation of outer EAC.

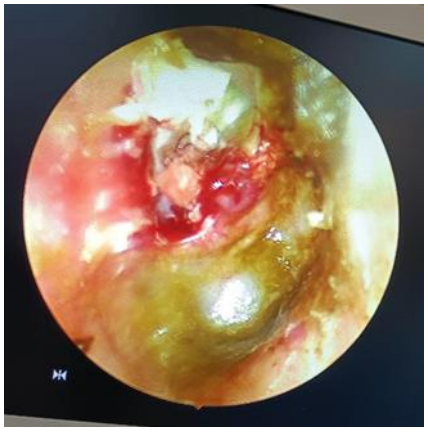

Figure 2: Inflamed external auditory canal with infectious debris insitu.

Table 1: Age distribution.

Age (years)	Frequency	Percentage (%)
<15	5	4.5
15-25	11	9.9
26-35	17	15.3
36-45	21	18.9
46-55	39	35.1
>55	18	16.3
Total	111	100

Bacterial otitis externa affected women more frequently (56.76%) than men (43.24%) (Table 2). Among those

impacted, 63 (72.41%) were rural residents while the remaining patients were urban residents. Casual labour was the most common occupation 41 (36.94%) among the affected population, followed by farmers 29 (26.13%) and drivers 21 (18.92%) (Table 3).

Table 2: Sex distribution.

Variable	Frequency	Percentage (%)
Male	48	43.24
Female	63	56.76
Total	111	100

Table 3: Occupation.

Variable	Frequency	Percentage (%)
Casual labourer	41	36.94
Employee	9	8.10
Farmer	29	26.13
Students	11	9.91
Driver	21	18.92
Total	111	100

The most prevalent symptoms among patients were ear pain (present in all patients), swelling in external auditory canal in 95 (85.58%), otorrhea in 87 (78.37%), itching in 83 (74.71%), diminished hearing in 81 (72.97%). Swelling of external auditory canal was frequently seen during an ear examination associated with tragal tenderness, and nearly all of the patients had two or more ear canal-related complaints (Table 4).

Table 4: Distribution symptoms and signs.

Variable	Frequency	Percentage (%)
Ear pain	111	100
Swelling in external auditory canal	95	85.58
Otorrhea	87	78.37
Itching	83	74.77
Reduced hearing	81	72.97

Table 5: Variation in bacterial species distribution.

Variable	Frequency	Percentage (%)
Gram positive org.	52	46.85
Cocci	34	65.39
Bacilli	15	28.84
Coccobacilli	3	5.77
Gram negative org.	59	53.15
Cocci	16	27.12
Bacilli	43	72.88
Total	111	

On gram staining of aural swabs, out of 111 patients 59 (53.15%) found to be gram negative and 52 (46.85%) were gram positive. Most commonly found organisms were gram negative bacilli 43 (72.88%).

On the culture reports most commonly isolated organism was *Pseudomonas aeruginosa* 39 (44.82%) followed by *Staphylococcus aureus* 34 (39.09%), *Klebsiella pneumoniae* 5 (5.75%), *Proteus mirabilis* 4 (4.60%), *Acinetobactor baumanni* 3 (3.44%), *Citrobactor freudii* 2 (2.30%). Antibiotic sensitivity as per culture report are shown in Table 7.

Table 6: Distribution of bacteria species in culture and sensitivity.

Bacterial species	Frequency	Percentage (%)
Pseudomonas aeruginosa	39	44.82
Staphylococcus aureus	34	39.09
Klebsiella pneumoniae	5	5.75
Proteus mirabilis	4	4.60
Acinetobactor baumanni	3	3.44
Citrobactor freudii	2	2.30
Total	87	

Table 7: Antibiotic sensitivity for the culture.

Bacterial species	Antibiotics
Pseudomonas aeruginosa	Piperacillin/tazobactum, aztreonam, tobramycin, ciprofloxacin
Staphylococcus aureus	Oxacillin, cotrimoxazole, clindamycin, erythromycin
Klebsiella pneumoniae	Cefotaxime, cefepime, levofloxacin
Proteus mirabilis	Ampicillin, amoxyclav, piperacillin/tazobactum
Acinetobactor baumanni	Ampicillin salbactum, levofloxacin, amikacin
Citrobactor freudii	Ceftriaxone, cefepime, levofloxacin

DISCUSSION

The most common age group presented with acute otitis externa in our study was 46-55 years that was supported by the study done by Ravishankar et al where 41-50 years age was commonly affected.[5] In a study done by Devinkar et al, most prevalent age group was 30-39 years and 41.8 years was the mean age observed in study by Kim et al.[6,7] The main reason came out to be poor aural hygiene and immunocompromised status in older age group.

The common presenting symptoms among patients in our study were ear pain (100%), swelling in external auditory canal (85.58%), otorrhea (78.37%), itching (74.71%), diminished hearing (72.97%) which were supported in study done by Hui CP, where otalgia (70%), itching (60%) or fullness (22%), with or without hearing loss (32%) were found.[8]

In our study gram negative organism were 53.15% and gram positive were 46.85%. Commonly isolated organism

was *Pseudomonas aeruginosa* (44.82%) followed by *Staphylococcus aureus* (39.09%), *Klebsiella pneumoniae* (5.75%), *Proteus mirabilis* (4.60%), *Acinetobactor baumanni* (3.44%), *Citrobactor freudii* (2.30%). Similar findings observed in study by Ravishankar et al where *Pseudomonas aeruginosa* being the most prevalent organism, accounting for (50%), followed by *Staphylococcus aureus* (20%), Coagulase-negative *Staphylococci* (CoNS) (10%), *Klebsiella pneumoniae* and *Proteus mirabilis* (6.7%) each. *Proteus vulgaris* and *Escherichia coli* were the least common, each accounting for (3.3%).[5]

In study done by Roland et al, most frequently isolated organism was *Pseudomonas aeruginosa* (38%) followed by *Staphylococcus epidermidis* (9.1%); *Staphylococcus aureus* (7.8%); *Microbacterium otitidis* (6.6%); *Microbacterium alconae* (2.9%); *Staphylococcus caprae* (2.6%); *Staphylococcus auricularis* (2.0%); *Enterococcus faecalis* (1.9%); *Enterobacter cloacae* (1.6%); *Staphylococcus capitis* subsp. *Ureolyticus* (1.4%); and *Staphylococcus haemolyticus* (1.3%).[9]

In study done by Kalra et al, the gram-negative organisms were 60%, and gram-positive 40%. *Pseudomonas aeruginosa* was the most common organism isolated (48%), followed by *Staphylococcus aureus* (36%).[10]

In study done Yabo et al, *Pseudomonas aeruginosa* (41.6%) was the most common bacteria isolated, followed by *Staphylococcus aureus* (16.9%); *Proteus mirabilis* (9.0%), *Escherichia coli* (5.2%), *Streptococcus pneumonia* (5.2%), *Klebsiella pneumoniae* (3.9%), *Streptococcus pyogenes* (3.9%), and *Enterobacter aerogenes* (2.6%).[11]

The susceptibility patterns of various bacterial species to antibiotics in our study were as follows- *Pseudomonas aeruginosa* is susceptible to piperacillin/tazobactum, aztreonam, tobramycin, and ciprofloxacin. *Staphylococcus aureus* is effectively treated with oxacillin, cotrimoxazole, clindamycin, and erythromycin. *Klebsiella pneumoniae*, *Citrobactor freudii*, and *Acinetobactor baumanni* show susceptibility to levofloxacin, with the latter two also responding to cefepime and cefotaxime, respectively. Additionally, *Proteus mirabilis* is effectively treated with ampicillin, amoxyclav, and piperacillin/tazobactum.

In study done by Roland et al, antibiotic resistance profiles were analyzed for various bacterial isolates, revealing notable trends. *Staphylococcus epidermidis* exhibited high-level resistance to neomycin (23%), oxacillin (11%), and ofloxacin (12%). In contrast, *Staphylococcus aureus* showed lower resistance rates to these antibiotics, with 6.3% resistant to neomycin, 2.7% to oxacillin, and 4.5% to ofloxacin. Resistance to quinolones and aminoglycosides was rare in *Pseudomonas aeruginosa*, whereas *Microbacteroccus otitidis* displayed intrinsic resistance to these antibiotic classes.[9]

In study done by Kalra et al, *Pseudomonas aeruginosa* isolates were found to be most susceptible to piperacillin + tazobactam and imipenem (100%), followed by cefepime (91.67%) and ciprofloxacin (87.5%) while the *Staphylococcus aureus* isolates were found to be most susceptible to linezolid (100%) and doxycycline (94.44%), followed by clindamycin (88.89%).[10]

In a study by Luthra et al, *Pseudomonas* demonstrated high sensitivity to imipenem, piperacillin/tazobactam, and ofloxacin, whereas cephalosporins showed the lowest effectiveness.[12]

CONCLUSION

In conclusion, aural swabs from 111 patients revealed a predominance of gram-negative organisms, with *Pseudomonas aeruginosa* and *Staphylococcus aureus* being the most common isolates. Antibiotic susceptibility testing showed that these organisms were susceptible to various antibiotics, including piperacillin/tazobactum, aztreonam, tobramycin, ciprofloxacin, oxacillin, and levofloxacin, highlighting the importance of targeted antibiotic therapy in treating aural infections.

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