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Bacteriological Profile and Antibiotic Susceptibility Pattern of Bloodstream Infection Isolates in a Tertiary Care Hospital

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Abstract: ***Background**: Bloodstream infections (BSIs) remain a major cause of morbidity and mortality worldwide. Early identification of causative organisms and their antimicrobial susceptibility patterns is crucial for appropriate therapy and improved patient outcomes. **Objective**: To identify the bacterial pathogens causing bloodstream infections and to determine their antibiotic susceptibility patterns in a tertiary care hospital. **Methods**: A hospital-based cross-sectional study was conducted over six months (January 2024–June 2024) among 874 patients clinically suspected of bloodstream infections admitted to intensive care units and wards of a tertiary care hospital in Bhubaneswar, India. Blood samples were collected aseptically prior to antibiotic administration and processed using conventional blood culture techniques. Isolates were identified by standard microbiological methods. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method as per Clinical and Laboratory Standards Institute (CLSI) guidelines. **Results**: Out of 874 blood samples, 134 (15.3%) were culture-positive. Gram-positive cocci constituted 55.9% of isolates, predominantly Staphylococcus aureus (45.5%), followed by coagulase-negative staphylococci (8.2%) and Enterococcus species (2.2%). Gram-negative bacilli accounted for 44.1% of isolates, with Klebsiella species (34.3%) being the most common, followed by Escherichia coli (4.4%), Acinetobacter species (2.9%), and Pseudomonas aeruginosa (2.2%). Gram-positive isolates showed high sensitivity to vancomycin (98%), linezolid (88%), and teicoplanin (88%). Gram-negative isolates were most sensitive to imipenem (79.6%) and meropenem (72.8%). **Conclusion**: Staphylococcus aureus and Klebsiella species were the predominant pathogens causing bloodstream infections. Carbapenems and glycopeptides remain effective against most Gram-negative and Gram-positive isolates, respectively. Continuous antimicrobial surveillance is essential to guide empirical therapy and combat emerging resistance.*

Keywords: bloodstream infections, antimicrobial susceptibility, Staphylococcus aureus, Klebsiella species, tertiary care hospital

1. Introduction

Bloodstream infections (BSIs) are among the most serious infections encountered in clinical practice and are associated with significant morbidity, mortality, prolonged hospital stay, and increased healthcare costs. BSIs may be caused by bacteria, viruses, fungi, or protozoa, with bacterial pathogens accounting for the majority of cases. Bacteremia refers to the presence of viable bacteria in the bloodstream without active multiplication, whereas septicemia involves active bacterial multiplication with systemic manifestations and toxin production.

Both Gram-positive organisms such as Staphylococcus aureus, coagulase-negative staphylococci (CoNS), and Enterococcus species, and Gram-negative organisms including Escherichia coli, Klebsiella species, Pseudomonas aeruginosa, and Acinetobacter species are commonly implicated in BSIs. The epidemiology and antimicrobial resistance patterns of these organisms vary across geographical regions and healthcare settings. Therefore, periodic local surveillance studies are essential for formulating effective empirical antimicrobial policies.

The present study was undertaken to determine the bacteriological profile of bloodstream infections and to analyze the antimicrobial susceptibility patterns of the isolated pathogens in a tertiary care hospital.

2. Materials and Methods

Study Design and Setting

This was a cross-sectional study conducted in the Department of Microbiology of a tertiary care hospital in Bhubaneswar, India, over a period of six months from January 2024 to June 2024.

Study Population

A total of 874 patients admitted to intensive care units and various wards with clinical suspicion of bloodstream infection were included in the study.

Sample Collection and Processing

Blood samples were collected aseptically before initiation of antibiotic therapy and inoculated into brain heart infusion broth. Culture bottles were incubated aerobically at 37°C and subcultured onto blood agar, MacConkey agar, and nutrient agar on day 2, day 4, and day 7.

Identification of Isolates

Bacterial isolates were identified based on colony morphology, Gram staining, and standard biochemical tests. Hemolysis patterns were observed on blood agar, lactose fermentation on MacConkey agar, and pigmentation on nutrient agar.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method, and results were interpreted according to CLSI guidelines. Antibiotics tested for Gram-positive isolates included vancomycin, teicoplanin, linezolid, doxycycline, levofloxacin,

erythromycin, chloramphenicol, gentamicin, and ofloxacin. Gram-negative isolates were tested against imipenem, meropenem, piperacillin-tazobactam, cefotaxime, amikacin, ampicillin, and ampicillin-sulbactam.

Samples showing no growth after seven days of incubation were reported as sterile.

3. Results

Out of 874 blood culture samples, 134 were culture-positive, yielding an overall positivity rate of 15.3%.

Distribution of Isolates
Gram-positive cocci accounted for 75 (55.9%) isolates, while Gram-negative bacilli constituted 59 (44.1%) isolates.

Gram-positive isolates:
- Staphylococcus aureus: 61 (45.5%)
- Coagulase-negative staphylococci: 11 (8.2%)
- Enterococcus species: 3 (2.2%)

Gram-negative isolates:
- Klebsiella species: 46 (34.3%)
- Escherichia coli: 6 (4.4%)
- Acinetobacter species: 4 (2.9%)
- Pseudomonas aeruginosa: 3 (2.2%) Antimicrobial Susceptibility Pattern

Gram-positive isolates demonstrated maximum sensitivity to vancomycin (98%), linezolid (88%), and teicoplanin (88%). Moderate sensitivity was observed with doxycycline (64%) and gentamicin (49.3%).

Gram-negative isolates showed highest sensitivity to imipenem (79.6%) and meropenem (72.8%), followed by piperacillin-tazobactam (59.3%) and ampicillin-sulbactam (49%). Resistance was notably high against ampicillin.

4. Discussion

In the present study, the blood culture positivity rate was 15.3%, which is comparable to similar studies conducted in tertiary care settings. Gram-positive organisms were the predominant isolates, accounting for 55.9% of cases, with Staphylococcus aureus being the most common pathogen.

Gill and Sharma reported a similar predominance of Gram-positive bacteria (53%) in bloodstream infections in North India. Another study from Manipur by Ningthoujam et al. observed an even higher proportion of Gram-positive isolates (75.3%). Variations in pathogen distribution may be attributed to differences in geographical location, patient population, prior antibiotic exposure, and hospital infection control practices.

High sensitivity of Gram-positive isolates to glycopeptides and oxazolidinones indicates their continued efficacy. However, the emergence of resistance to commonly used antibiotics underscores the importance of antimicrobial stewardship.

5. Conclusion

Staphylococcus aureus and Klebsiella species were the most common pathogens isolated from bloodstream infections in this study. Carbapenems remain the most effective agents against Gram-negative bacilli, while vancomycin, teicoplanin, and linezolid is highly effective against Gram-positive cocci. Continuous monitoring of antimicrobial resistance patterns is essential for guiding empirical therapy and improving patient outcomes, particularly in resource-limited settings.

References

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