Section: Microbiology

Original Research Article

ANTIBIOTIC SENSITIVITY TEST OF GRAM NEGATIVE BACTERIAL ISOLATES FROM MEDICAL AND SURGICAL INTENSIVE CARE UNIT AT TERTIARY CARE HOSPITAL

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Abstract

Background: Patients in intensive care units are more prone to nosocomial infections caused by hospital strains of bacteria or opportunistic pathogens. Because of extensive use of broad-spectrum antibiotics; these strains are often resistant to many antimicrobials**. Materials and Methods:** This prospective study was carried out at the Department of Microbiology, JLNMCH, Bhagalpur, Bihar from April 2022 to March 2023**.** Clinical isolates isolated from different ICUs from clinical specimens were included in the study. Repeat isolates from the same patient from repeat specimen were excluded from the study to avoid duplication of isolate. Specimens included were pus, endotracheal secretions, sputum, urine, stool, cerebrospinal fluid, blood, and body fluids such as ascitic fluid, peritoneal fluid, pleural fluid, and other specimens such as catheter tips, knee aspirate, and corneal scrapings. Processing of the specimens was done on blood agar, chocolate agar, and Mac Conkey's agar. Bacterial colonies were identified by and antimicrobial susceptibility testing was to detect minimum inhibitory concentrations. Results of all the isolated strains, isolated during study period, were included for data analysis in the study. For this, MS Excel software was used. **Results:** A total of 1933 clinical isolates identified during the study period were included in the study project. Bacterial distribution was as shown in Table 1 with the highest being Klebsiella spp. (n = 464). This was followed by E. coli (n = 386), Acinetobacter spp. (n = 348), P. aeruginosa (n = 312), and S. aureus (n = 294) with the least isolated being Salmonella spp. (n = 9). **Conclusion:** Optimum antimicrobial utilization in ICUs is important for better patient outcome and to prevent emergence of multidrug resistance. This can be achieved by strict infection control measures such as stringent adherence to hand washing practices, universal safety precautions, antibiotic policy formulation, and its implementation along with antibiotic stewardship program.

INTRODUCTION

Patients in intensive care units are more prone to nosocomial infections caused by hospital strains of bacteria or opportunistic pathogens.[1] Because of extensive use of broad-spectrum antibiotics, these strains are often resistant to many antimicrobials.[2] Since there are differences in susceptibility patterns among hospitals, the hospital-wise antibiogram is useful for clinicians in the initial choice of antibiotics.[3] Antimicrobial resistance pattern may also vary among individual hospital wards. If organisms isolated from patients in the intensive care units (ICUs) are more resistant but not in other hospital wards, this important information could be masked by the use of a hospital-wide antibiogram.[4] This is very important for the rational use of empirical therapy in critically ill patients.[5,6]
There are very few published reports available on the microbial analysis of patient's samples and determination of antibacterial susceptibility patterns in this region from ICUs. Such data could be beneficial for the use of appropriate antimicrobials, reducing the duration of stay in the hospital, and also reducing the morbidity and mortality rate.[4,5] Furthermore, findings of such regional studies can be useful region wise or state wise, which may be helpful for preparing antibiotic policy.

MATERIALS AND METHODS

This prospective study was carried out at the Department of Microbiology, JLNMCH, Bhagalpur, and Bihar from April 2022 to March 2023.

Inclusion Criteria

Clinical isolates isolated from different ICUs from clinical specimens were included in the study.

Exclusion Criteria

Repeat isolates from the same patient from repeat specimen were excluded from the study to avoid duplication of isolate.

The clinical specimens received from ICUs in this period were included. Different ICUs were medicine intensive care unit (MICU), paediatric intensive care unit (PICU), cardiac intensive care unit (CICU), and surgery intensive care unit (SICU). Specimens included were pus, endotracheal secretions, sputum, urine, stool, cerebrospinal fluid, blood, and body fluids such as ascitic fluid, peritoneal fluid, pleural fluid, and other specimens such as catheter tips, knee aspirate, and corneal scrapings. Processing of the specimens was done on blood agar, chocolate agar, and Mac Conkey's agar.[7] Bacterial colonies were identified and antimicrobial susceptibility testing was done detect minimum inhibitory concentrations.[8] For this, antimicrobials used in the panel were amikacin, ceftazidime, ciprofloxacin, ceftriaxone, colistin, cefazolin, cefepime, nitrofurantoin, gentamicin, imipenem, levofloxacin, meropenem, piperacillin, ampicillin/ sulbactam, trimethoprim/sulfamethoxazole, tigecycline, ticarcillin, piperacillin/tazobactam, cefoperazone/sulbactam, tetracycline, ticarcillin, piperacillin/tazobactam, and vancomycin.

Interpretation of the test was done as per the Clinical and Laboratory Standards Institute (2015) guidelines.[9] Quality control of the test was done by standard ATCC strain Escherichia coli 25922, Pseudomonas aeruginosa 27853, and Staphylococcus aureus 29213.[9,10] Results of all the isolated strains, isolated during study period, were included for data analysis in the study. For this, MS Excel software was used.

RESULTS

A total of 1933 clinical isolates identified during the study period were included in the study project. Bacterial distribution was as shown in Table 1 with the highest being Klebsiella spp. (n = 464). This was followed by E. coli (n = 386), Acinetobacter spp. (n = 348), P. aeruginosa (n = 312), and S. aureus (n = 294) with the least isolated being Salmonella spp. (n = 9).

Table 1: Distribution of bacteria among clinical isolates

Bacteria	Frequency (n)
Klebsiella spp.	464
Acinetobacter spp.	348
E. coli	386
P. aeruginosa	312
S. aureus	294
Enterobacter spp.	37
Enterococcus spp.	30
Proteus spp.	30
Citrobacter spp.	13
Serratia spp.	13
Salmonella spp.	9
Total	1933

E. coli: Escherichia coli, P. aeruginosa: Pseudomonas aeruginosa, S. aureus: Staphylococcus aureus

Table 2: Distribution of clinical isolates among ICU

ICU name	Frequency (%)
MICU	1251(75.57)
CICU	105 (5.45)
PICU	5 7(2.98)
SICU	520 (29.28)
Total	1933(100)

ICU: Intensive care units, MICU: Medicine ICU, CICU: Cardiac ICU, PICU: Paediatric ICU, SICU: Surgery ICU

Most bacterial isolates (n = 1251) were from MICU, which contributed to 75.07% of the total isolates with minimum isolates were from PICU (2.98 %) [Table 2].

Maximum isolates were from endotracheal tube (ETT) followed by urine, sputum, and pus. The Nine Salmonella spp. were isolated from stool specimens. Of the different species, Klebsiella spp. Acinetobacter spp. and P. aeruginosa were isolated from ETT-related specimens. Maximum E. coli, S. aureus, Enterococcus spp, and Proteus spp. were isolated from urine.

Antimicrobial sensitivity pattern of the different major bacterial isolates to different antimicrobials. Major number of Gram-negative isolateswere resistant to β-lactam antimicrobials and β-lactam/β-lactamase inhibitor combination. Resistance was

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also shown to quinolone and to some extent carbapenem group.

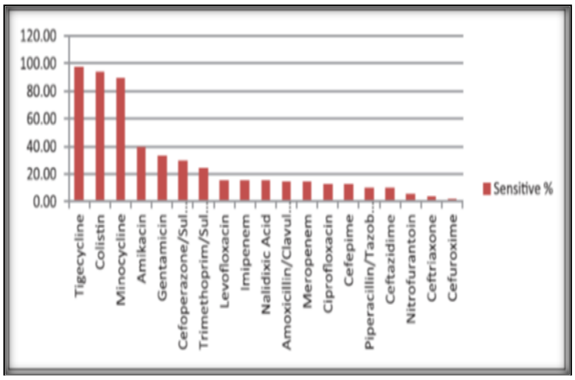

Figure 1: Acinetobacter spp. Antimicrobial sensitivity pattern

What was alarming was 46 (15.79%) strains of S. aureus were resistant to vancomycin. Similarly, vancomycin-resistant enterococci were 14% (n = 5).
Colistin, tigecycline, minocycline, imipenem, and meropenem were the most common sensitive drugs forE. coli, Klebsiella spp. Acinetobacter spp., and P. Aeruginosa Nearly, 77.65% and 69.61% of E. coli were sensitive to amikacin and nitrofurantoin, respectively.

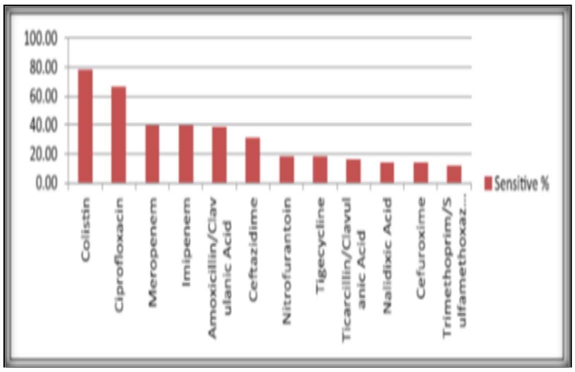

Figure 2: Pseudomonas spp. Antimicrobial sensitivity pattern

Klebsiella spp. showed only 46.86% sensitivity to imipenem Except tigecycline, colistin, and minocycline, all other antimicrobials showed <40% sensitivity for Acinetobacter spp. P. aeruginosa showed 69.56% and 32.95% sensitivity to ciprofloxacin and meropenem, respectively.

DISCUSSION

The most important goal for any ICUs should be reduction in antimicrobial resistance.[11] this will ensure better patient outcome and will reduce the cost of antibiotics and also patient's duration of ICUs stay.[11] for this, it is important to have knowledge of bacterial profile and antibiogram of particular ICUs in any hospital.
In the present study, Klebsiella spp. followed by Acinetobacter spp. was the most frequently isolated organism. This is correlating with the type of clinical specimens with the main source being respiratory tract that is ETT and sputum. Similar findings were observed by Hanberger et al.[12] Ventilator-associated pneumonia is the most frequent ICU's infection.[13] Up to 40% of these can be polymicrobial.[13] This explains that most frequent number of clinical isolates in the present study were from MICU compared to SICU and CICU, as that of carried out by Javeri et al.[14]
High level of resistance was observed to cephalosporin group. Antimicrobials such as cefepime, ceftazidime, ceftriaxone, and cefazolin showed >40% of sensitivity. This might be due to the widespread use of cephalosporins. Similar findings with higher percentage of sensitivity was observed by Singh et al.[15] Combination drugs such as beta lactam and beta lactamase inhibitor may be useful to some extent, but the sensitivity to these drugs in the present study is causing worrisome in the present therapeutic scenario. In fact, studies have shown high prevalence resistance among Gram-negative bacteria as compared to Gram-positive bacteria in India.[16]
Quinolones in the present study showed a high degree of resistance as compared to carbapenem group. Similar findings were observed by Singh et al.[15]
Colistin, tigecycline, minocycline, amikacin, imipenem, and meropenem were the most common sensitive drug for Gram-negative clinical isolates, ranging from 54% to 79% of sensitivity. Studies conducted in India have shown more percentage of sensitivity for this antibiotics.[14-17]
Colistin has its own limitations because of its toxicity. Tigecycline and minocycline are showing higher sensitivity in this region because of its no use or very limited use. This signifies the rotational use of antimicrobials to improve sensitivity. Also, the use of carbapenem group for treatment has resulted in decline in sensitivity to these antibiotics compared to other studies.[14,15]
Among Gram-positive cocci, S. aureus showed more sensitivity to vancomycin, trimethoprim, sulfamethoxazole, nitrofurantoin, and least sensitivity to penicillin and quinolone groups. Regular surveillance of antimicrobial sensitivity pattern is important for guiding clinicians in the therapy of infected patients.[18]

CONCLUSION

Amikacin and carbapenem groups were the most useful antimicrobials in ICUs infections in present study. Cephalosporin group showed the maximum resistance, with limitation in treatment. Although colistin was most effective against all Gram-negative organisms, its use should be monitored considering its toxicity.
Optimum antimicrobial utilization in ICUs is important for better patient outcome and to prevent

emergence of multidrug resistance. This can be achieved by strict infection control measures such as stringent adherence to hand washing practices,14,15 universal safety precautions, antibiotic policy formulation, and its implementation,14 following antimicrobial stewardship program with rotational, restricted, and combinational use of antimicrobials.

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