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Research Article

BACTERIOGICAL PROFILE OF CRITICALLY ILL PATIENTS IN INTENSIVE CARE UNIT IN BANGALORE

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ABSTRACT

Objective: Intensive care units (ICUs) are considered as the epicentre of infections due to its vulnerable conditions for development, amplification, and dissemination of drug-resistant microorganisms. Furthermore, the use of inappropriate or incorrect antibiotics is also closely related to development and spread of drug-resistant microorganisms. Hence, the present study was conducted in a private hospital in South Bangalore, to evaluate the spectrum of micro organisms isolated from clinical samples of patients admitted in ICU and their antimicrobial susceptibility pattern.

Methods: This observational study was conducted on critically ill patients admitted in medical ICUs of private hospital in south Bangalore, Karnataka, India. The study was designed to include all patients with age 18 years or older, admitted for more than 48 h in medical ICUs of the hospital and having at least two of the clinical signs of SIRS. Depending on the clinical suspicion, clinical samples such as pus, blood, urine, body fluids, respiratory specimen were collected. The samples collected were first subjected to gram staining and then were inoculated on blood agar and MacConkey agar plates taking proper aseptic precautions. Antimicrobial sensitivity patterns of respective organisms were studied on Mueller Hinton agar media by Kirby Bauer's disk diffusion method.

Results: A total of 665 clinical samples were received in the microbiology laboratory out of which 60% samples showed significant microbial growth. The most predominant isolates were Gram-negative organisms 72.68% and Gram-positive isolates were seen in 27.3%. Sample-wise distribution of positive culture was done. Pus 33%, respiratory specimen 26%, urine 20%, blood 15%, and body fluids 6%. Majority of Gram-negative isolates were susceptible to amikacin, followed by piperacillin/tazobactum, cefeperazone/salbactum and imipenem and high resistance rates to ampicillin, amoxy clav was noted. Most of the *Staphylococcus aureus* were sensitive to linezolid, vancomycin, followed by amikacin, pipercillin/tazobactum, and cefeperazone/salbactum.

Conclusion: The present study showed the high prevalence of aerobic bacteria in clinical samples of critically ill patients in ICUs. The study identified both Gram-positive and Gram-negative organisms to be responsible for causing blood stream infections. There should be continuous surveillance of data of clinical isolates along with their sensitivity pattern with routine surveillance for baseline resistance, stringent hospital infection policy, and their implementation in the hospital is the need of the hour to stop or reduce drug resistance.

Key words: Intensive care units, Aerobic bacterial pathogens, Antibiotic resistance.

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INTRODUCTION

Intensive care units (ICUs) are the specialized sections in a hospital where critically ill patients are taken care of there are multiple factors that make these patients particularly prone to infections such as preexisting comorbid conditions, exposure to multiple invasive monitoring devices, intravascular catheters, and procedures compromising the anatomical barrier defenses, impairment of protective mechanisms, use of sedatives, muscle relaxants, immunosuppressive drugs, and the frequent impairment of the immune response induced by trauma, surgery, and sepsis [1,2].

Apart from this, ICUs are often considered the epicentre of infections due to its vulnerable conditions for development, amplification, and dissemination of drug-resistant microorganisms [3,4]. Furthermore, the use of inappropriate or incorrect antibiotics is also closely related to development and spread of drug-resistant microorganisms [5,6]. For these reasons, nosocomial infections, often caused by multidrug resistant bacteria (MDR), are more common in ICUs than in other departments [7].

With this background, the present study was conducted in a private hospital in South Bangalore, to evaluate the spectrum of micro organisms isolated from clinical samples of patients admitted in ICU and their antimicrobial susceptibility pattern.

METHODS

This observational study was conducted from December 2021 to June 202 on critically ill patients admitted in medical ICUs of private hospital in South Bangalore, Karnataka, India.

The study was designed to include all patients with age 18 years or older, admitted for more than 48 h in medical ICUs of the hospital and having at least two of the clinical signs of SIRS. Patients with the previous hospital admission or antibiotic use in the past 1 month were excluded from the study. Patients showing clinical signs of infection on or before admission or transfer to the ICUs were not included in the study.

Detailed history including the name, age, sex, underlying clinical condition, date of admission to the ICU, and any history of previous antibiotic intake were noted. Immediately after admission and before starting antibiotics, the specimen was labeled with the patient's name, specimen type, and the date and time of collection. Furthermore, the treatment being administered in the ICU and clinical outcome of each patient was noted.

All samples were collected as per standard aseptic protocol and universal precautions were followed [8]. Depending on the clinical

suspicion, clinical samples such as pus, blood, urine, body fluids, and respiratory specimen were collected. The samples were brought to microbiology laboratory immediately and were processed within 30 min of collection, and if a delay of more than 1–2 h was expected, the specimen was refrigerated.

Sample processing and identification of organisms to the species level and their antimicrobial susceptibility tests were carried out as per standard laboratory procedures. The samples collected were first subjected to gram staining and then were inoculated on Blood agar and Mac Conkey agar plates taking proper aseptic precautions. The plates were incubated aerobically at 37°C for 18–24 h. After overnight incubation, the isolates were identified by their cultural characteristics, colony morphology, and biochemical tests. Antimicrobial sensitivity patterns of respective organisms were studied on Mueller Hinton agar media by Kirby Bauer's disk diffusion method. Commercially available discs (HiMedia Laboratories, Mumbai, Maharashtra, India) were used and placed on the surface of the inoculated media and then incubated overnight.

RESULTS

During the period from December 2021 to June 2022, a total of 665 clinical samples were received in the microbiology laboratory out of which 399/665 (60%) samples showed significant microbial growth.

Among the samples which showed significant growth, 240/399 (60.15%) were from male and 159/399 (39.84%) were from female patients.

	Number	%
Male	240/399	(60.15)
Female	159/399	(39.84)

The most predominant isolates were Gram-negative organisms 290/399 (72.68%) and Gram-positive isolates were seen in 109/399 (27.3%). *Escherichia coli* 96/290 (33.1%) was the most common Gram-negative isolate followed by *Klebsiella* spp. 84/290 (28.96%), *Citrobacter* 52/290 (17.93%), and *Acinetobacter* 29/290 (10%), *Pseudomonas* 23/290 (7.93%), and *Proteus* 6/290 (2.06%) were the other most common pathogens isolated among Gram-negative organisms. *Staphylococcus aureus* 50/109 (45%) was the most predominant gram-positive isolate followed by coagulase negative staphylococci (CoNS) 32/109 (32%) and *Enterococcus* 23/109 (23%).

Isolates from blood stream infections (BSIs)

Gram-negative	290/399	56.36%
Gram-positive	109/399	27.3%
Escherichia coli	96/290	33.1%
Klebsiella spp	84/290	28.96%
Citrobacter spp	52/290	17.93%
Acinetobacter spp	29/290	10%
Pseudomonas	23/290	7.93%
Proteus mirabilis	6/290	2.06%
Staphylococcus aureus	50/109	45%
CoNS	32/109	32%
Enterococcus	23/109	23%

Sample-wise distribution of positive culture was done. Pus – 132/399 (33%), respiratory specimen – 103/399 (26%), urine – 78/399 (20%), blood – 58/399 (15%), and body fluids – 24/399 (6%).

Samples	Number	%
Pus	132/399	33
Respiratory specimen	103/399	26
Urine	78/399	20
Blood	58/399	15
Body fluids	24/399	6

All the isolates showed varying antibiotic sensitivity pattern. Majority of Gram-negative isolates were susceptible to amikacin, followed by piperacillin/tazobactum, cefeperazone/salbactum and imipenem and high resistance rates to ampicillin, amoxy clav was noted. Third-generation cephalosporins showed a very weak activity against them. Carbapenems showed good activity against all the isolates with susceptibility of 91% for *E. coli* and 87% for *Klebsiella* and *Citrobacter* spp.

Most of the *S. aureus* were sensitive to linezolid, vancomycin, followed by amikacin, pipercillin/tazobactum, and cefeperazone/salbactum. Coagulase-negative Staphylococcus was more resistant to the antibiotics than *S. aureus*. *Enterococcus* spp. isolated was sensitive to most of the antibiotics.

DISCUSSION

Patients admitted to ICUs tend to develop BSIs, which lead to increase in morbidity and mortality among these patients. The epidemiology of microorganisms causing BSIs dramatically changed over years, with a concomitant increase in antimicrobial resistance. A nationwide surveillance study conducted in 49 hospitals in USA showed a large prevalence of gram-positive bacteria causing BSIs compared with Gram-negative isolates. However, the recent trend shows an increasing incidence of Gram-negative organisms causing BSIs [9]. With over and indiscriminate use of antibiotics in ICU settings, they have led to higher prevalence of MDR microorganisms under continues antibiotic pressure.

A total of 665 clinical samples were received in the microbiology department out of which 43.6% of samples showed significant growth of microorganisms.

In our study, it was noted that BSI was more common male patients, in agreement with several studies [10-12]. The predominance of men appears without explanation. Zhang *et al*. [13] reported that catheterization, mechanical ventilation, and urinary catheter were considered as risk factors for bacteremia acquisition. Our study supported the correlation of this factors and the high incidence found, since almost all of our population has been exposed to such maneuvers in ICU.

This study found that sputum culture was positive for pathogen in 26% of the studied patient. This study was very low comparable with that of Patel *et al*. [14] The difference may be related to the type of studied patients, where our study was done on critically ill ICU patients, whereas most of other studies were done on patients with respiratory illness who were admitted to the ward or outpatients.

In our study, there was predominance of Gram-negative organisms (72.68%) which is consistent with studies in recently published international observational study providing information about bacteremia from 1156 ICU patients worldwide [15].

Among the Gram-negative organisms, the most predominant organism isolated in our study was *E. coli* (33.1%) which is in accordance to study conducted by Kumar *et al*. (*E. coli* 46.42%) [16] and Banerjee *et al*. (*E. coli* 25%) [17]. This was in contrast to a study done by Anurag *et al*. in which the most frequent bacteria were *Pseudomonas aeruginosa* (38.17%) [13]. *Klebsiella pneumoniae* was the second organism causing bacteremia in our study with a rate of 28.96%. This value is higher than that reported in other studies [10].

Among the Gram-positive organisms, the most predominant organism isolated in our study was *S. aureus* (45%), followed by CoNS (32%). This was in contrast to other studies, where CoNS was the most predominant organism, as stated by Savanur and Gururaj (43.75%) [18] and Zaveri *et al*. [19], whereas in a study done by Kumar *et al*. isolation rate of CoNS was just 1.78% [16].

The blood culture positivity rate in our study was 15%, which is low in comparison with various studies. Blood culture positivity rate in a

study done in Ethiopia by Ali and Kebede (24.2%) [20]. Studies from India by Gill and Sharma (24.8%) [21], Arora and Devi (20.02%) [22], and Sharma *et al*. (33.9%) [9].

The antimicrobial resistance profile showed high degree of resistance to Gram-positive and Gram-negative microorganisms. Among Gram- negative organisms (*E coli*, *K. pneumoniae*, *Acinetobacter baumannii*, *P. aeruginosa,* and *Proteus* sp), the present study noted piperacillin tazobactum, cefeperazone/salbactum, and meropenem was the most effective antibiotic. Third-generation cephalosporins showed a very weak activity against them. This was comparable to study done by Patel *et al*., [10] they found that the Piperacillin Tazobactum was the most effective antibiotic against Gram-positive and Gram-negative bacteria. All the GNB showed poor susceptibility to beta-lactam antibiotics. The fact that the beta-lactam antibiotics are the most commonly prescribed drugs for both inpatients and outpatients could be the reason for such high level of resistance.

S. aureus in this study represented 45% of positive cultures. This rate is similar to other data reported by other studies [23]. All the Gram-positive organisms showed good susceptibility to linezolid, and vancomycin ranging from 71 to 98%, and we did not encounter any resistance to vancomycin in our isolates; this result is similar to studies [24]. A study done by Chakraborty *et al*. [25] also found that among the Gram-positive organisms, linezolid was found to be sensitive in all the cases, followed by vancomycin. The high efficacy of linezolid and vancomycin is due to little use of them because of many causes, as these antibiotics are expensive and have frequent adverse effects.

CONCLUSION

BSIs continue to be the most important cause of mortality in ICU patients, particularly when infection is caused by MDR microorganisms. Appropriate and timely antibiotic therapy using combination strategies is the cornerstone for treatment of complex infections.

The present study showed the high prevalence of aerobic bacteria in clinical samples of critically ill patients in ICUs. The study identified both Gram-positive and Gram-negative organisms to be responsible for causing BSIs. This implies that cultures must always be done in suspected cases of bacteremia, and once the susceptibility profile of the organism is known, the de-escalation of the high-end antibiotics should be encouraged to reduce antimicrobial pressure. Moreover, there should be continuous surveillance of data of clinical isolates along with their sensitivity pattern with routine surveillance for baseline resistance, stringent hospital infection policy and their implementation in the hospital is the need of the hour to stop or reduce drug resistance.

AUTHORS CONTRIBUTION

Dr. Shruthi N and Dr. Ramesha KT, Planned the study; Dr. Shruthi N and Dr. Ravish Kumar M, Conducted the study; Dr. Shruthi N and Dr. Ramesha KT, Analysed the study.

CONFLICTS OF INTERESTS

None.

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Self.

PATIENT CONSENT

Obtained during IP admission.

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