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Original article

Antimicrobial susceptibility pattern of Gram-negative bacteria isolated from blood stream infection from intensive care unit in tertiary care teaching hospital.

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Abstract:

Introduction: Blood stream infections range from self-limiting infections to life threatening septicaemia that requires rapid and aggressive antimicrobial treatment [(1)]. Mortality due to blood steam infection ranges from 20% to 50%. **Objectives:** The present study was undertaken to analyse the various Gram-negative microorganisms causing blood stream infections and study their antimicrobial resistance patterns in a tertiary care hospital, to guide the clinicians for formulating antimicrobial policies for empirical therapy. **Methodology:** Blood culture was collected from 218 patients admitted in intensive care unit and incubated at 37^0c aerobically and then subculture was made on blood agar and MacConkey agar on 2^{nd},4^{th} and 5^{th} day. Organisms were identified according to colony morphology and standard biochemical tests. The antimicrobial susceptibility testing of all isolates was done by the Kirby-Bauer disc diffusion method according to CLSI (Clinical Laboratory Standards Institute) guidelines. **Results:** Out of total 83 cases of culture positive isolates, 43 (51.80%) were Gram negative bacilli and 40 (48.20%) were Gram positive cocci. Among Gram negative bacilli, *Klebsiella pneumoniae* was the most common organism 18 (41.86%) followed by *Escherichia coli* 11(25.58%), *pseudomonas aeruginosa* 9 (20.93%), *Citrobacter freundii* 3(6.98%) and *Acinetobacter baumanii* 2(4.65%). Amongst 10 antibiotics tested, Imipenem followed by Piperacillin/Tazobactam and amikacin showed highest activity against *Enterobacteriaceae* family isolates. **Conclusion:** Blood stream infections are an important cause of morbidity and mortality due to drug resistance among isolates. To decrease mortality, continuous surveillance of infection among patients admitted in intensive care unit and to study antimicrobial drug resistance among isolates is important.

Key words: Blood stream infections, Gram negative bacteria, Antibiotic susceptibility pattern

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Introduction

Blood stream infections range from self-limiting infections to life threatening septicaemia that requires rapid and aggressive antimicrobial treatment [1]. Mortality due to blood steam infection ranges from 20% to 50% [2]. If microorganism invade blood stream either continuously, intermittently or transiently it causes serious risk to every organ of body [3]. Risk factors contributing to these infections are many but leading causes are intravascular catheters (IVCs), debilitating condition of the patients due to some underlying disease or invasive diagnostic or therapeutic procedures.[4] Since early 1950s, there is striking increase in incidence of bacteraemia caused by members of *Enterobacteriaceae* family and other Gram-negative bacilli [5,6] *Escherichia coli* which was reported to be common in the past is being replaced by other multi drug resistant (MDR) bacteria like Klebsiella, Enterobacter, Salmonella, Citrobacter, Pseudomonas, Acinetobacter spp. etc.[5] The infections caused by MDR organism are more likely to prolong the hospital stay, increase the risk of death and require treatment with more expensive antibiotics. This increasing antimicrobial resistance is a worldwide concern and is subjected to regional variation.[7] Blood culture is the most important procedure for the detection of bloodstream infection.[8] However, before considering these aspects, the choice of antibiotic mainly relies on the knowledge of the pathogen likely involved, monitoring and analysing the antimicrobial susceptibility pattern of most frequently isolated microorganisms according to local epidemiology which helps clinicians to choose empirical therapies and develop rational prescription policy for antibiotics.[9]

Therefore, the present study was undertaken to analyse the various Gram-negative microorganisms causing blood stream infections and study their antimicrobial resistance patterns in a tertiary care hospital, to guide the clinicians for formulating antimicrobial policies for empirical therapy.

Material and methods

The present study was prospective type with approval from Institutional ethics committee. Blood culture was collected from 218 patients admitted in intensive care unit during July 2019 to June 2020. Clinicians were asked to collect 8-10 ml of blood in brain heart infusion broth before starting antibiotics with strict aseptic precautions [10] Incubate at 37^0c aerobically and then subculture was made on blood agar and MacConkey agar on 2^{nd},4^{th} and 5^{th} day. [10] Organisms were identified according to colony morphology and standard biochemical tests. The antimicrobial susceptibility testing of all isolates was done by the Kirby-Bauer disc diffusion method according to CLSI (Clinical Laboratory Standards Institute) guidelines [14].

Statistical analysis

The data were recorded in the MS excel and analysed **by using software -SPSS version 20**. Qualitative data was presented in the form of percentages.

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Results

Total 218 patient's blood culture were received from intensive care unit during study period. Out of 218 patients, 106 (48.62%) were males and 112 (51.38%) females. Among 218 patients, 83(38.07%) were culture positive and 135(61.93%) were culture negative.

Table: 1 sex-wise distribution of culture positive patients (n=218)

Sex	Culture Positive (%)	Culture Negative (%)	Total (%)
Male	44 (41.51%)	62 (58.49%)	106 (100%)
Female	39 (34.82%)	73 (65.18%)	112 (100%)
Total	83 (38.07%)	135 (61.93%)	218 (100%)

Out of total 83 cases of culture positive isolates, 43 (51.80%) were Gram negative bacilli and 40 (48.20%) were Gram positive cocci. Among Gram negative bacilli, *Klebsiella pneumoniae* was the most common organism 18 (41.86%) followed by *Escherichia coli* 11(25.58%), *pseudomonas aeruginosa* 9 (20.93%), *Citrobacter freundii* 3(6.98%) and *Acinetobacter baumanii* 2(4.65%).

Table 2: Antimicrobial susceptibility pattern of isolates from *Enterobacteriaceae family*

Antibiotics	*Klebsiella pneumoniae(n=18)*	*Escherichia coli (n=11)*	*Citrobacter freundii (n=3)*	Total (n=32)
Ampicillin	0(0%)	8(72.73%)	0(0%)	8 (25%)
Cefazolin	0(0%)	1(9.09%)	0(0%)	1 (3.15%)
Cefuroxime	1(5.56%)	1(9.09%)	1(33.34%)	3 (9.37%)
Ceftriaxone	8(44.45%)	3(27.28%)	1(33.34%)	12 (37.5%)
Imipenem	18(100%)	10(90.90%)	3(100%)	31 (96.87%)
Piperacillin-tazobactam	17(94.44%)	9(81.82%)	2(66.67%)	28 (87.5%)
Amikacin	13(72.23%)	8(72.73%)	2(66.67%)	23 (71.87%)
Gentamicin	11(61.12%)	7(63.64%)	1(33.34%)	19 (59.37%)
Ciprofloxacin	12(66.67%)	6(54.55%)	1(33.34%)	19 (59.37%)
cotrimoxazole	7(38.79%)	2(18.19%)	1(33.34%)	10 (31.25%)

Amongst the antibiotics tested, Imipenem followed by Piperacillin/Tazobactam and amikacin showed highest activity against *Enterobacteriaceae* family isolates.

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Table 3: Antimicrobial susceptibility pattern of non-fermenters

Antibiotics	*Pseudomonas aeruginosa (n=9)*	*Acinetobacter baumannii (n=2)*	Total (n=11)
ceftazidime	6(66.67%)	1(50%)	7 (63.64%)
cefepime	7(77.78%)	1(50%)	8 (72.73%)
gentamicin	3(33.34%)	1(50%)	4 (36.36%)
amikacin	7(77.78%)	2(100%)	9 (81.82%)
imipenem	8(88.89%)	2(100%)	10 (90.91%)
Piperacillin-tazobactam	8(88.89%)	2(100%)	10 (90.91%)
ciprofloxacin	4(44.45%)	1(50%)	5 (45.45%)

Amongst the antibiotics tested, Imipenem and Piperacillin/Tazobactam followed by amikacin showed highest activity against non-fermenters isolated from blood stream infection cases.

Discussion

Antimicrobial drug resistance among bacteria is an alarming problem in the therapy of bloodstream infections. [17,18] as septicaemia is life threatening condition; therefore, timely detection, identification, and antimicrobial susceptibility testing of isolates from blood stream infections is essential. In our study, out of 218 patients, 106 (48.62%) were males and 112 (51.38%) were females. It is comparable with study conducted by Meremkwer MM *et al* [19] and Kavitha prabhu *et al* [20]. Among 218 blood culture samples, 83 (38.08%) were culture positive which is quite similar to Khanal *et al.* [21] and Divyashanthi *et al* [22]. In India, variation in blood culture positivity rates might be due to the fact that most of the patients are given antibiotics before they come to the tertiary care hospital, and the other reason may be self-medication.

Out of 83 culture positive samples, 43 (51.80%) were Gram negative isolates and 40(48.20%) were Gram positive isolates. This finding is similar to several other studies in Lahore (50.1% vs 47.5%) [23], Uganda (58% vs 42%) [24]. This is considerable that, different etiological agents of bloodstream infections can be related to the varying demography of bloodstream infections in developing countries because of different geographical area. The most common isolate among Gram negative bacteria is *Klebsiella pneumonieae* (18) followed by *E. coli* (11) and *pseudomonas aeruginosa* (9). Difference in study design, number of study population, blood culture system, geographical location, and epidemiological difference of the etiological agents, variations in infection control policies between nations may be possible explanations for variation in isolates in different studies.

Amongst the antibiotics used, imipenem, piperacillin/Tazobactam and amikacin, showed highest activity against Gram negative isolates in our study. Our result was in good agreement with the findings of earlier studies conducted by Kurtoğlu MG., et al[25]and Fayyaz M., et al. [26]

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Conclusion

It is concluded that blood stream infections are an important cause of morbidity and mortality due to drug resistance among isolates. To decrease mortality, continuous surveillance of infection among patients admitted in intensive care unit and to study antimicrobial drug resistance among isolates is important.

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