Section: Microbiology

Original Research Article

A STUDY ON MICROBIOLOGICAL PROFILE AND ANTIMICROBIAL RESISTANT PATTERN OF BLOOD CULTURE ISOLATES IN CRITICAL CARE UNITS IN A TERTIARY CARE HOSPITAL IN NORTH INDIA

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Received : 05/07/2024
Received in revised form : 04/09/2024
Accepted : 21/09/2024

Keywords:
BSI, Antimicrobial resistance, Blood isolates.

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DOI: 10.47009/jamp.2024.6.5.45

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (5); 244-248

Abstract

Background: Bloodstream infections, also known as sepsis, are severe life threatening infections with a mortality rate of up to 50%.. Bloodstream infections (BSI) constitute a significant global health issue due to their contribution to high mortality rates hospitalized patients. Untreated or incorrectly treated infections can lead to sepsis, septic shock, organ failure, and death. **Materials and Methods:** This study was a hospital based retrospective cross-sectional study carried out in tertiary care hospital in North india.The data was collected by reviewing the records of 186 patients admitted to various critical care units (ICUs) of the hospital from June 2023 to Dec 2023. Bacterial growth was identified up-to species level by morphology and conventional biochemical tests using standard protocols. Antimicrobial susceptibility testing was performed by disc diffusion method (Kirby-Bauer method) according to CLSI guidelines. **Result:** Out of these patients 119 were (63.97%) were males. In our study total no sterile culture is 138. total no of positive blood culture was 48. In the present study, out of these isolates 21 /186 (11.29%) were Gram positive bacteria (GPB) and 26/186 (13.97%) were Gram negative bacteria (GNB) and one isolate were of Candida species. The predominant bacterial isolate were Coagulase negative staphylococcus (CONS) (7.52%), followed by E.coli (5.91%), Klebsiella (4.83%). Staphylococcus aureus (2.68%), Enterococcus species (1.07%) and Candida (0.53%). Gram negative isolates, Out of 2 Pseudomonas species, showed highest resistance for Cefixime 2(100%), Ampicillin-Sulbactam 2(100%) and cotrimoxazole 1(50%) and good sensitivity for Imipenem 2 (100%), piperacillin-tazobactem 1(50%). out of 14 CONS. species, 12 showed highest resistance to penicillin (85.71%), followed by Erythromycin 11(78.57%) and cotrimoxazole 5(35.71%). The antimicrobial resistance profile of both Gram positive and Gram negative isolates showed a high prevalence of resistance among them. **Conclusion:** Bloodstream infections are a medical emergency and antibiotics are central and pivotal in saving lives. Judicial usage of antibiotics while preventing antibiotic misuse is a challenge especially in severely ill patients.

INTRODUCTION

Bloodstream infections, also known as sepsis, are severe life threatening infections with a mortality rate of up to 50%. Bloodstream infections (BSI) constitute a significant global health issue due to their contribution to high mortality rates hospitalized patients. Untreated or incorrectly treated infections can lead to sepsis, septic shock, organ failure, and death. Globally, sepsis affects approximately 50 million people, resulting in approximately 11 million deaths yearly.[1-3]

Emergence of resistance among the bacterial pathogens causing these infections is another issue of the public health concern. Studies have shown that there is a wide range of bacteria, both Gram negative and Gram positive which are associated with this infections. Early identification of the causative pathogen and start of appropriate treatment can significantly reduce the morbidity, hospital stay and mortality among patients with BSIs.[2-6] Bloodstream infections (BSIs) significantly impact global health and economics.[7-11] In 2017, there were about 49 million sepsis cases worldwide, leading to 11 million deaths, 41% of which affected children under 5.14 In

ISSN (O): 2687-5365; ISSN (P): 2753-6556

India, the burden is particularly high, with an estimated caseload of 11 million and a mortality rate of 3 million.[12]

MATERIALS AND METHODS

Study design & data collection: This study was a hospital based retrospective cross-sectional study carried out in tertiary care hospital of SKMCH, Muazaffarpur, North India. The data was collected by reviewing the records of 186 patients admitted to various critical care units (ICUs) of the hospital from June 2023 to Dec 2023. The samples of these patients were routinely processed for blood culture in the department of Microbiology. Data collection included age & sex of the patients, the results of the blood culture and antimicrobial sensitivity testing (AST).

Blood samples were collected from the patients taking all aseptic & antiseptic measures. For all samples phlebotomy was performed after disinfection of vein puncture site with 70% alcohol followed by 2% tincture iodine. During the study period, 5-10 ml blood from each adult patient was taken and inoculated in blood culture bottle. 50 ml brain heart infusion broth media (Hi media) was used in bottle. Bottles were incubated aerobically for 7 days, in an incubator at 37˚C and subculture were done on Nutrient agar, MacConkey agar & blood agar plates. After 48 hours and 7 days, in between these time points subcultures were done if visible turbidity was found. Bacterial growth was identified up-to species level by morphology and conventional biochemical tests using standard protocols. Antimicrobial susceptibility testing was performed by disc diffusion method (Kirby-Bauer method) according to CLSI guidelines.

Statistical analysis: For statistical analysis SPSS version 17.0 software and MS excel 2007 were used. We also used Chi-square test to know the association between the variable.

RESULTS

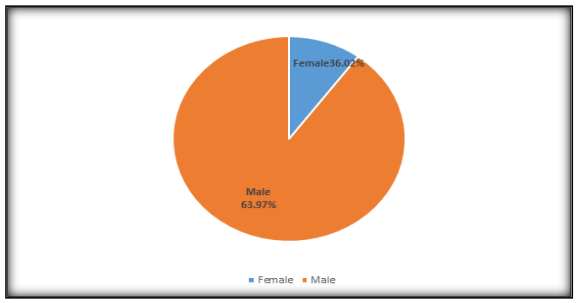

Figure 1: ?

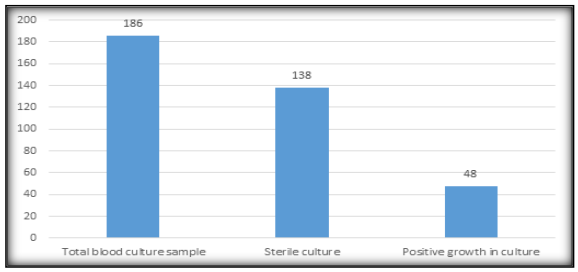

Figure 2: Growth profile of the blood culture samples

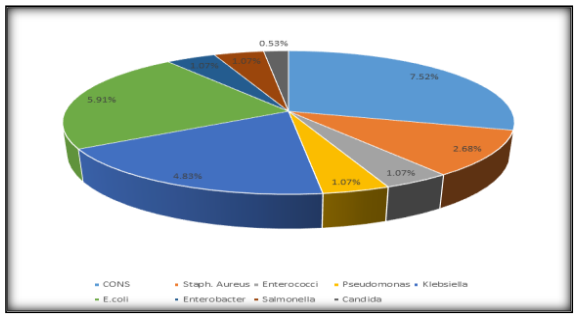

Figure 3: Showing Distribution of isolates obtained from blood culture samples

Table 1: Showing male and female distribution.

Sn.no	Total	Male	Female
1.	186	119 (63.97%)	67 (36.02%)

Table 2: Growth profile of the blood culture samples.

Sn.no			Percentage (%)
1.	Total blood culture sample	186	
2.	Sterile culture	138	74.19%
3.	Positive growth in culture	48	25.80%

Table 3: Distribution of isolates obtained from blood culture samples

S. No.	Isolates	Total No.	%
1.	CONS	14	7.52
2.	S. aureus	5	2.68
3.	Enterococci	2	1.07
5.	TOTAL GPC		
6.	Pseudomonas	2	1.07
7.	Klebsiella	9	4.83
8.	E. Coli	11	5.91
9	E nterobacter	2	1.07
10.	Salmonella	2	1.07
	TOTAL GNB		
11	Candida	1	0.53
12.	TOTAL	48/186	
	Blood culture Positivity (%)	25.80%	

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 4: Antimicrobial resistance (%) of various Gram positive isolates

Organisms	CONS (14)		Staphylococcus aureus (5)		Enterococcus (2)	
Antibiotics	**Sensitive**	**Resistant**	**Sensitive**	**Resistant**	**Sensitive**	**Resistant**
Gentamycin	12 (85.71%)	2 (14.28%)	3 (60%)	2 (40%)	NT	NT
Ciprofloxacin	11 (78.57%)	3 (21.42%)	3 (60%)	2 (40%)	1 (50%)	1 (50%)
Cotrimoxazole	9 (64.28%)	5 (35.71%)	2 (40%)	3 (60%)	NT	NT
Cefoxitin	12 (85.71%)	2(14.28%)	2 (40%)	3 (60%)	0 (0.00%)	2 (100%)
Penicillin	2 (14.28%)	12 (85.71%)	1 (20%)	4 (80%)	0 (0.00%)	2 (100%)
Erythromycin	3 (21.42%)	11(78.57%)	2 (40%)	3 (60%)	2 (100%)	0 (0.00%)
Linezolid	13 (92.85%)	1 (7.14%)	4 (80%)	1 (20%)	2(100%)	0 (0.00%)
Vancomycin	14 (100%)	0 (0.00%)	5 (100%)	0 (0.00%)	2 (100%)	0 (0.00%)
Ampicillin-Sulbactam	12 (85.71%)	2 (14.28%)	4 (80%)	1 (20%)	1 (50%)	1 (50%)

Table 5: Antimicrobial resistance (%) of various Gram-negative isolates:-

Organisms	Pseudomonas (2)		Klebsiella (9)		E.coli (11)		Enterobacter (2)		Salmonella spp (2)	
Antibiotics	**Sensitive**	**Resistant**	**Sensitive**	**Resistant**	**Sensitive**	**Resistant**	**Sensitive**	**Resistant**	**Sensitive**	**Resistant**
Imipenem	2 (100%)	0 (0.00%)	9 (100%)	0 (0.00%)	9 (81.81%)	2 (18.18%)	1 (50%)	1 (50%)	2 (100%)	0 (0.00%)
Amikacin	1 (50%)	1 (50%)	3 (33.33%)	6 (66.66%)	8 (72.72%)	3 (27.27%)	2 (100%)	0 (0.00%)	1 (50%)	1 (50%)
Ampicillin-Sulbactam	0 (0.00%)	2 (100%)	4 (44.44%)	5 (55.55%)	9 (81.81%)	2 (18.18%)	2 (100%)	0 (0.00%)	2 (100%)	0 (0.00%)
Gentamycin	1 (50%)	1 (50%)	3 (33.33%)	6 (66.66%)	10 (90.90%)	1 (9.09%)	1 (50%)	1 (50%)	2 (100%)	0 (0.00%)
Ciprofloxacin	1 (50%)	1 (50%)	5 (55.55%)	4 (44.44%)	7 (63.63%)	4 (36.36%)	2 (100%)	0 (0.00%)	1 (50%)	1 (50%)
Cefixime	0 (0.00%)	2 (100%)	4 (44.44%)	5 (55.55%)	8 (72.72%)	3 (27.27%)	2 (100%)	0 (0.00%)	2 (100%)	0 (0.00%)
Ceftazidime	0 (0.00%)	2 (100%)	2 (22.22%)	7 (77.77%)	7 (63.63%)	6 (54.54%)	2 (100%)	0 (0.00%)	2 (100%)	0 (0.00%)
Cotrimoxazole	1 (50%)	1 (50%)	6 (66.66%)	3 (33.33%)	7 (63.63%)	4 (36.36%)	2 (100%)	0 (0.00%)	1 (50%)	1 (50%)
Piperacillin-Tazobactem	1 (50%)	1 (50%)	7 (77.77%)	2 (22.22%)	9 (81.81%)	2 (18.18%)	2 (100%)	0 (0.00%)	2 (100%)	0 (0.00%)

DISCUSSION

A total of 186 blood samples of the patients suspected of bacteraemia, admitted to critical care units of the hospital were processed routinely for blood culture in the department of Microbiology from June 2023 to Dec 2023. Out of these patients 119 were (63.97%) were males. In our study total no sterile culture is 138. total no of positive blood culture was 48. Our study is in accordance with the study done by Sumanth Gandra et al,[3] (2016) who also found (61.4%) male.

In the present study, out of these isolates 21 /186 (11.29%) were Gram positive bacteria (GPB) and 26/186 (13.97%) were Gram negative bacteria (GNB) and one isolate were of Candida species. Study done by Mohamed Ali Jinna et al,[4] (2023) also reported the incidence of gram-negative bacteremia to be higher (54.6%) than gram-positive (45.4%).

In the present study, the predominant bacterial isolate were Coagulase negative staphylococcus (CONS) (7.52%), followed by E.coli (5.91%), Klebsiella (4.83%). Staphylococcus aureus (2.68%), Enterococcus species (1.07%) and Candida (0.53%) as shown in table 3. In the study done by Anitha Deva et al,[5] (2023) also showed that Gram-negative bacteria were the most predominant isolates in the study compared to gram-positive bacteria, accounting for 58.76% of BSI.

Our study is similar to the study done by Manmeet Kaur Gill et al,[2] (2016) showed that the predominant bacterial isolate were Coagulase negative staphylococcus (CoNS) 49 (34.5%) followed by Acinetobacter 22 (15.4%) and Staphylococcus aureus 20 (14%). Similar observations were found in the study done by Ritu Bhatnagar et al (2018) that the Gram-positive cocci accounted for 53.16% and Gram negative for 46.50% and candida species as 0.33% of positive cultures and Coagulase negative staphylococcus (38.12%), Staphylococcus aureus (13.04%), Pseudomonas species (13.71%) and Klebsiella species were predominant organisms.[13,14]

In the present study , Gram negative isolates, Out of 2 Pseudomonas species, showed highest resistance for Cefixime 2(100%) , Ampicillin-Sulbactam 2(100%) and cotrimoxazole 1(50%) and good sensitivity for Imipenem 2 (100%) ,piperacillin-tazobactem 1(50%) and amikacin 1 (50%), Gentamycin 1 (50%) .Out of 9 Klebsiella species ,showed high resistance to ceftazidime 7 (77.77%), Gentamycin 6 (66.66%) and good sensitivity for Imipenem (100%), followed by piperacillin-tazobactem 7 (77.77%) .Out of 11 E.coli species, showed high resistance to Ceftazidime 6 (54.54%) and good sensitivity for Gentamycin 10(90.90%), Imipenem 9 (81.81%). Similarly Out of 2 Enterobacter species, showed high resistance to Imipenem 1 (50%) and (50%) Gentamycin1 (50%) and good sensitivity for Amikacin 2 (100%), Ciprofloxacin 2(100%), Ampicillin-Sulbactam 2(100%). Out of 2 Salmonella species, one showed high resistance to Ciprofloxacin 1(50%) and good sensitivity for Imipenem an Ampicillin-Sulbactam 2(100%). In Gram-positive isolates, high resistance to different antibiotics was observed in CONS and Staphylococcus aureus.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

In the present study, out of 14 CONS species, 12 showed highest resistance to penicillin (85.71%), followed by Erythromycin 11(78.57%) and cotrimoxazole 5(35.71%). CONS showed good sensitivity to Vancomycin (100%), followed by Linezolid 12(85.71%), Gentamycin (80.70%) and Ampicillin-Sulbactam 12(85.71%). Out of 5 Staphylococcus aureus, resistance to penicillin 4(80%), Erythromycin 3(60%), cotrimoxazole 3(60%) and Gentamycin 2 (40%). Staphylococcus aureus showed good sensitivity to Vancomycin (100%), followed by Linezolid 2 (40%), Ampicillin-sulbactam 2 (40%).

In a study done by Sajib MI et al,[8] (2023) Monteforte M, Go R. Clinical Outcome of Cefiderocol for infections with Carbapenem-Resistant Organisms. Antibiotics (Basel). 2023;12(5):936. doi:10.3390/antibiotics12050936Gram-positive cocci (GPC), Gram-negative bacilli (GNB) and Candida sp. are frequently isolated from culture positive BSI. Recent studies suggest Gram-negative bacteremia is mostly responsible among these patients,[6,7] and increased reports of multidrug resistant GNB (MDRGNB) e.g., carbapenem-resistant Enterobacterales (CRE), carbapenem-resistant Acinetobacter baumannii (CRAB) and difficult-to-treat resistance Pseudomonas aeruginosa (DTR-P. aeruginosa) are available.[8]

Knowledge of pathogens causing BSI and their antimicrobial susceptibility patterns are crucial for timely initiation of appropriate empirical antimicrobial therapy in febrile neutropenic patients with haematological malignancies.[9]

Study done by Anitha Deva et al,[10] also found that among the gram-positive bacteria, the sensitivity of Enterococcus species ranged from 76% to 21%; vancomycin sensitivity was 76%, followed by penicillin, ampicillin, and high-level gentamicin at 60.8%, erythromycin, and doxycycline at 26%, levofloxacin at 23.9% and linezolid at 21.7%. The sensitivity of Staphylococcus aureus ranged from 100% to vancomycin and 4.5% to penicillin. The sequence of sensitivity after vancomycin was to linezolid (95.5%), tetracycline and doxycycline at 90.9%, chloramphenicol (81.8%), gentamicin (72.7%), clindamycin and cotrimoxazole (63.6%), erythromycin (40.9), amoxicillin/ clavulanic acid (31.8%), ciprofloxacin (22.7%) and penicillin (4.5%).

Similar findings were found in the study done by Ritu Bhatnagar et al,[14] (2018) in which GPC were showing high resistance to penicillin (82.46%), followed by Erythromycin (73.68%), Ciprofloxacin (56.14%) and cotrimoxazole (52.63%), but most of the isolates were susceptible to vancomycin & linezolid (zero resistance pattern). GNB resistant to Cefixime (97.56%) and cotrimoxazole (95.12%) and good sensitivity for Imipenem (100%), piperacillin-tazobactem (70.73%) and amikacin (53.66%). This shows the narrow range of antimicrobial choice for the treatment of blood stream infections which can be life threatening. Irrational use of powerful antibiotics for prolonged period with compromised host conditions might be responsible for emergence of multi drug resistant strains.

CONCLUSION

Bloodstream infections are a medical emergency and antibiotics are central and pivotal in saving lives. Judicial usage of antibiotics while preventing antibiotic misuse is a challenge especially in severely ill patients. Moreover, stringent hospital infection control measures and a good antibiotic policy for the hospital is the need of the hour. High utilization rate of antibiotics is the most important contributory factor for the development of AMR and continuous surveillance is needed in order to keep national guidelines on antimicrobial therapy updated.

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