Bacteriological profile and antibiotic resistance pattern in blood stream infection in critical care units of a tertiary care hospital in North India

Manmeet Kaur Gill[1,*], Sarabjeet Sharma[2]

[1]Assistant Professor, [2]Professor & Head, Dept. of Microbiology, Sri Guru Ram Institute of Medical Sciences & Research, Amritsar

***Corresponding Author:**
Email: drmanmeetgill@gmail.com

Abstract

Background: Blood stream infections (BSIs) are an important cause of morbidity and mortality worldwide. The condition can be life threating in critically ill patients in intensive care unit (ICUs) of the hospital. Emergence of resistance among the bacterial pathogens causing these infections is another issue of the public health concern.

Objectives: This study was carried out in our hospital which is attached to a medical college in North India, to know the spectrum of bacterial pathogens causing BSIs in the patients admitted to the critical care units also to know the trends of resistance among these agents.

Materials & Methods: It was a hospital based retrospective cross-sectional study and was carried out in tertiary care hospital in North India. The data was collected by reviewing the records of 565 patients admitted to various critical care units (ICUs) of the hospital from May 2015 to March 2016.

Results: Out of total 565 blood samples of the patients suspected of bacteremia, admitted to critical care units of the hospital 140 were culture positive. Out of these isolates 74(53%) were Gram positive bacteria (GPB) and 55(39.3%) were Gram negative bacteria (GNB) and 11(7.9%) were non-albicans Candida. The predominant bacterial isolate were Coagulase negative staphylococcus (CoNS) 49 (34.5%) followed by *Acinetobacter* 22 (15.4%) and *Staphylococcus aureus* 20 (14%). The antimicrobial resistance profile of both Gram positive and Gram negative isolates showed a high prevalence of resistance among them.

Conclusion: The present study will provide the clinicians an update on high prevalence of multi-drug resistant isolates in the critical care units of the hospital.

Keywords: Blood stream infections, Critical care units, Multi-drug resistance

Access this article online	
Quick Response Code:	Website: www.innovativepublication.com
	DOI: 10.5958/2394-5478.2016.00059.5

Introduction

Blood stream infections (BSIs) are an important cause of morbidity and mortality worldwide. The condition can be life threatening in critically ill patients in intensive care units (ICUs) of the hospitals. The case fatality rate associated with BSIs in ICU patients is between 35% - 50%[1]. 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/infection or invasive diagnostic or therapeutic procedures[2-4].

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[5-8]. The diagnosis of these infections can easily be made with blood culture and since blood is a sterile fluid, the positive predictive value of a blood culture is high. Early identification of the causative pathogen and start of appropriate treatment can significantly reduce the morbidity, hospital stay and mortality among patients with BSIs.

This study was carried out in our hospital which is attached to a medical college in North India to know the spectrum of bacterial pathogens causing BSIs in the patients admitted to the critical care units and also to know the trends of resistance among these agents.

Material and Methods

Study design & data collection: Ours was a hospital based retrospective cross-sectional study carried out in tertiary care hospital of S.G.R.D Institute of Medical Science and Research, Amritsar, North India. The data was collected by reviewing the records of 565 patients admitted to various critical care units (ICUs) of the hospital from May 2015 to March 2016. 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. Five of blood was collected for adults and 2 ml

for paediatric age group which was then inoculated in brain heart infusion (BHI) broth 50ml and 10 ml respectively. Blood culture bottles were incubated at 37ºC aerobically for 24 hrs followed by subcultures on a blood agar plate and MacConkey's agar. Blood culture broth which did not show any signs of bacterial growth (hemolysis or turbidity) were reported negative after 7 days of incubation, after doing a final subculture. Isolates were identified by Vitek 2 Compact (Biomerieux) using gram negative, gram positive and yeast identification cards and AST cards for sensitivity. Antibiotic sensitivity results were interpreted as per CLSI guidelines.

Ethical approval: The study was conducted after getting ethical approval from the ethical committee of the institution.

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

A total of 565 blood samples of the patients suspected of bacteremia, admitted to critical care units of the hospital were processed routinely for blood culture in the department of Microbiology from May 2015 to March 2016. Out of these patients 379 were (67%) were males. Male to female ratio was approximately 2:1. Medium age of the patients was 43 years with a range from 1 day to 85 years. In our study total no of positive blood culture was 140. Out of these isolates 74(53%) were Gram positive bacteria (GPB) and 55(39.3%) were Gram negative bacteria (GNB) and 11(7.9%) were non-albicans Candida (Fig. 1).

The predominant bacterial isolate were Coagulase negative *staphylococcus* (CoNS) 49 (34.5%) followed by *Acinetobacter* 22 (15.4%) and *Staphylococcus aureus* 20 (14%) (Fig. 2, Table 1). In addition there were 11 isolates of Candida species, all non albicans with *Candida utilis* (9) being the predominant species followed by *Candida tropicalis* (2). All blood stream infections were due to a single organism only.

Antibiotic susceptibility patterns: Antibiotic resistance patterns of the isolates recovered from blood cultures is shown in Fig 3&4. Among Gram positive bacterial isolates, 100% isolates of CONS and *Enterococcus* and 85% isolates of *Staphylococcus aureus* were resistant to penicillin and oxacillin. However most of the GPB were sensitive to teichoplanin, daptomycin and linezolid and 100% were sensitive to vancomycin (Fig. 3).

Among Gram negative bacterial isolates, *Acinetobacter* and *Klebsiella* were dominant species in descending order. Third generation cephalosporins showed a very weak activity against them. carbapenem resistance was detected in 64% isolates of *Acinetobacter spp.* and in 92% of *Klebsiella pneumonia*. 100% stains of both species were multidrug resistant (MDR). However most of their strains were sensitive to both tegicycline and colistin (Fig. 4).

Table 1: Showing age wise frequency of bacterial isolates recovered from patients with BSI

Age of patient	Number and % of organism isolated									
	Gram positive cocci (53%)			Gram negative bacilli (39.3%)						Candida
	CoNS (49) 35%	*S.aureus (20) 14.3%*	*Enterococcus (5) 3.6%*	*Acinetobacter (22) 15.7%*	*Klebsiella (12) 8.6%*	*Enterobacter (8) 5.6%*	*E. coli(6) 4.3%*	*Pseudomonas (5) 3.6%*	*Burkholderia cepacia (2) 1.4%*	*Non albican 11(7.9%)*
<28 days	29	11	5	13	8	8	2	1	2	9
<5 yrs	6	2	0	2	1	0	0	0	0	2
5-15 yrs	7	4	0	3	1	0	1	1	0	0
>15 yrs	7	3	0	4	2	0	3	3	0	0

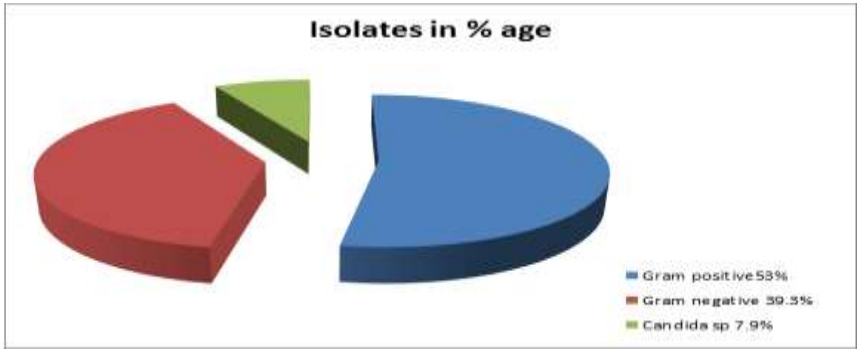

Fig. 1: Pie chart showing % age distribution of Bacterial isolates recovered from patients with BSI

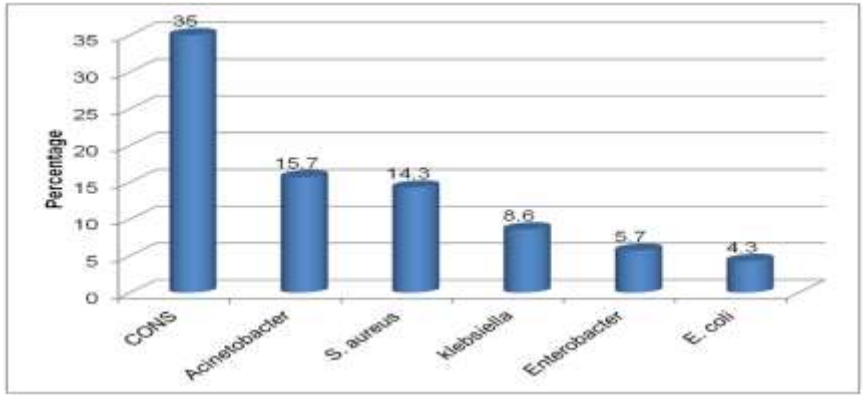

Fig. 2: Graph showing frequency of bacterial isolates recovered from patients with BSI

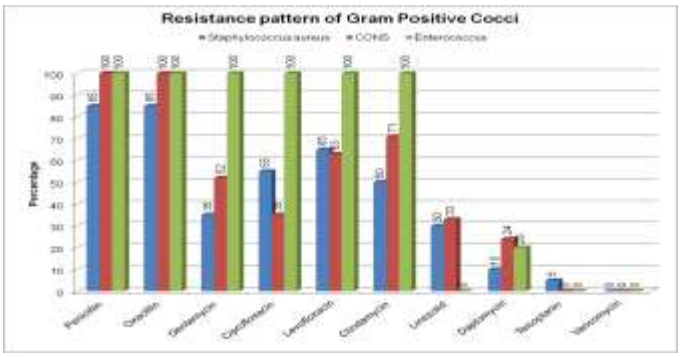

Fig. 3: Graph showing antibiotic resistance pattern in Gram positive isolates

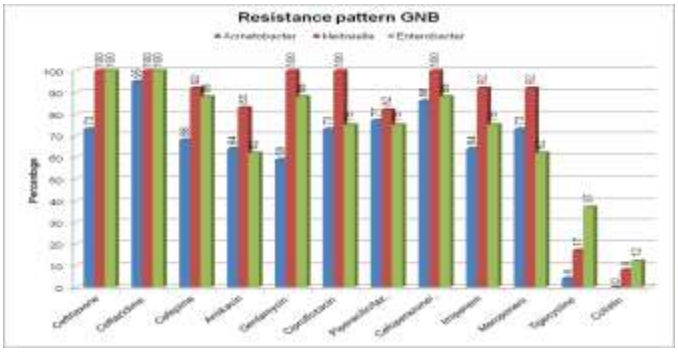

Fig. 4: Graph showing antibiotic resistance pattern in Gram negative isolates

Discussion

Patients admitted to the critical care units of the hospitals are always at a higher risk of developing nosocomial BSIs which results in high morbidity and mortality among these patients. This study was done to know the spectrum of pathogens causing BSIs in the patients admitted to the critical care units of our hospital and also to know the trends of resistance among them.

The results of the study showed the microbial profile of the blood stream infections as well as the resistance pattern of the isolates as follows. Out of total 565 patient's blood samples, 140 were culture positive; the rate of isolation was 24.8% which was comparable to other studies from India and abroad. Similar results were also shown by a study done in Gonder, Ethiopia, 24.2% by Ali and Kebede *et al* in 2008[9]. Studies from India by Arora *et al* 2007[10] (20.02%) and Sharma *et al* 2002[11] (33.9%) also showed comparable results. Slight variation may be due to many factors like geographical locations, patient type, timing and number of blood cultures or difference in blood culture system[9-11].

There is a wide range of organisms which can cause BSIs and same has been studied by many researchers. In our study 53% of the infections were caused by Gram positive bacteria and 39.3% were due to Gram negative bacteria. There are several studies from different parts of the world which show a higher prevalence of Gram-positive over Gram-negative organisms; a study by Wasihun *et al.* 2015[12] showed 72.2% of infections were caused by GPB and 27.8% by GNB, Dagnew *et al* 2013[13] at Gonder Ethiopia (69% and 31% respectively) and Obi and Mazarura in Zimbabwe 1996 (71.9% and 28.1%)[12-14]. Among GPB, CoNS was the most frequently isolated pathogen and this has also been reported by other studies conducted in the country[15-17]. Reason for high incidence of CoNS probably was that most of the samples were received from the neonatal intensive care unit (NICU). Although CoNS can be a skin contaminant but it is now a well-described pathogen associated with prematurity and central venous lines.

On the contrary, in most of the studies from India and other developing counties, Gram-negative bacteria have been reported as the commonest cause of bacteremia in hospitalized patients; studies in India by Singh *et al* 2014[15] with 51.82% GNB and 46.56% GPB and Alam *et al* in 2011[16] and a Nigerian study by Nwadioha *et al.* 2010[18] (69.3 GNB and 30.7% GPB)[15,16,18].

Candida was reported in 7.9% of positive blood culture and all were non albicans Candida species. Predominant specie was *Candida utilis* and all the 9 isolates were reported in neonates. There are only few cases in literature that has reported *Candida utilis* candidaemia in neonates[19].

In our study we also notice a significant number of cases with septicemia were in neonates. A higher rate of occurrence in neonatal septicemia has been reported by previous studies also[13,20].

The antimicrobial resistance profile of both GP and GN isolates showed a high prevalence of resistance

among them. CoNS and Enterococcus spp isolates showed higher level of resistance to beta-lactam antibiotics than Staphylococcus aureus. However all the three were sensitive to vancomycin which is similar to other studies[12,21].

Most of the Gram-negative bacteria were MDR with a very high resistance to beta-lactam antibiotics. Among Gram negative bacterial isolates, *Acinetobacter* and *Klebsiella* were dominant species. Third generation cephalosporins showed a very weak activity against them. Carbapenem resistance was detected in 64% isolates of *Acinetobacter spp.* and in 92% of *Klebsiella pneumonia*. This might be due to inappropriate empirical use of meropenem as the first line treatment. As many as 8% isolates of *klebsiella spp* and 12% of *Enterobacter spp* were even resistant to colistin.

Conclusion

The present study showed prevalence of multi-drug resistant isolates in critical care patients and this limits the therapeutic options. It implies that blood cultures must always be done in all cases of suspected bacteremia and septicemia and once the sensitivity pattern of the isolate is known de-escalation of the high-end antimicrobials should be considered to reduce the antimicrobial pressure. Moreover stringent hospital infection control measures and a good antibiotic policy for the hospital is the need of the hour.

References

1. RussottoV et al. Bloodstream infections in intensive care unit patients: distribution and antibiotic resistance of bacteria. Infection and Drug Resistance.2015;vol 8;287-96
2. Mathur P, Varghese P, Tak V. Epidemiology of Blood Stream Infections at a Level-1 Trauma Care Center of India. J Lab Physicians. 2014 Jan-Jun;6(1):22–27.
3. Taylor G, Buchanan-Chell M, Kirkland T, Mckenzie M, Wiens R. Long term trends in the occurrence of nosocomial blood stream infection. Can J Infect Dis. 2000;11:29–33.
4. Passerini R, Ghezzi T, Sandri M, Radice D, Biffi R. Ten-year surveillance of nosocomial bloodstream infections: Trends of aetiology and antimicrobial resistance in comprehensive cancer centre. E cancer medical science. 2011;5:191.
5. Asrat D, Amanuel Y: Prevalence and antibiotic susceptibility pattern of bacterial isolates from blood culture in Tikur Anbessa hospital, Addis Ababa. Ethiopia. Ethiop Med J. 2001, 39 (Suppl 2):97-104.
6. James AK, Mark EJ, Deborah CD, Clyde T, Daniel FS, Gregory AV: Prevalence and antimicrobial susceptibilities of bacteria isolated from blood cultures of hospitalized patients in the United States in 2002. Ann Clin Microbio Antimicrobi. 2004, 3 (Suppl 7): 1-8.
7. Rina K, Nadeem SR, Kee PN, Parasakthi N: Etiology of blood culture isolates among patients in a multidisciplinary teaching hospital in Kuala Lumpur. J Microbiol Immunol Infect. 2007,40:432-437.
8. Manjula M, Pyria D, Varsha G: Antimicrobial susceptibility pattern of blood isolates from a teaching Hospital in north India. Japan J Infec Dis. 2005,58:174-176.
9. Ali J, Kebede Y: Frequency of isolation and antimicrobial susceptibility pattern of bacterial isolation from blood culture in Gondar University Hospital. Ethio Med J. 2008,46(2):155-161.
10. Arora U, Devi P. Bacterial profile of blood stream infections and antibiotic resistance pattern of isolates. J K Sci 2007;9:186-190.
11. Sharma M, Goel N, Chaudhary U, Aggarwal R, Arora DR. Bacteraemia in children. Indian J Pediatr 2002;69:1029-32.
12. Wasihun, A.G., Wlekidan, L.N., Gebremariam, S.A., et al. (2015) Bacteriological Profile and Antimicrobial Susceptibility Patterns of Blood Culture Isolates among Febrile Patients in Mekelle Hospital, Northern Ethiopia. Springer Plus,4,314.
13. Dagnew M, Yismaw G, Gizachew M, Gadisa A, Abebe T, Tadesse T et al (2013) Bacterial profile and antimicrobial susceptibility pattern in septicemia suspected patients attending Gondar University Hospital, Northwest Ethiopia. BMC Res Notes 6:283.
14. Obi CL, Mazarura E: Aerobic bacteria isolated from blood cultures of patients and their antibiotic susceptibilities in Harare, Zimbabwe. Cent Afr J Med. 1996, 42 (Suppl 12): 332-336.
15. Singh AK, Venkatesh V, Singh RP, Singh M, Bacterial and antimicrobial resistance profile of bloodstream infections: A hospital based study. CHRISMED Journal of Health and Research 2014;1(3);140-144.
16. Alam MS, Pillai PK, Kapur P, Pillai KK. Resistant patterns of bacteria isolated from bloodstream infections at a university hospital in Delhi. J Pharm Bioallied Sci 2011;3:525-30.
17. Khanna V, Mukhopadhayay C, Vandana KE, Verma M, Dabke P. Evaluation of central venous catheter associated blood stream infections: A microbiological observational study. J Pathog 2013;2013:936864.
18. Nwadioha I, Nwokedi EOP, Kashibu E, Odimayo MS, Okwori EE 2010 A review of bacterial isolates in blood cultures of children with suspected septicemia in a Nigerian. Afr J Microbiol Res 4(4):222–225.
19. Lukić-Grlić A., Mlinarić-Missoni E., Skarić I., Vazić-Babić V., Svetec I. K. 2011. Candida utilis candidaemia in neonatal patients. J Med Microbiol 60, 838–841.
20. Angyo IA, Opkeh ES, Opajobi SO: Predominant bacterial agents of childhood septicaemia in Jos. Niger J Med. 2001,10:75-77.
21. Soriano A, Marco F, Martinez JA, Pisos E, Almela M, Dimova VP et al (2008) Influence of vancomycin minimum inhibitory concentration on the treatment of methicillin-resistant S. aureus bacteremia. Clin Infect Dis 46:193–200.

How to cite this article: Gill MK, Sharma S. Bacteriological profile and antibiotic resistance pattern in blood stream infection in critical care units of a tertiary care hospital in North India. Indian J Microbiol Res 2016;3(3):270-274.