<u>**ORIGINAL RESEARCH**</u>

Bacteriological profile of Blood stream infections in ICUs

[1]Dr. Shivani Gupta, [2]Dr. Deepinder Chhina, [3]Dr. Veenu Gupta, [4]Dr. Rajesh Mahajan

[1]Senior Resident, [2]Ex-Professor & Head, [3]Professor & Head, Department of Microbiology, Dayanand Medical College and Hospital, Ludhiana, Punjab, India
[4]Professor, Department of Medicine, Dayanand Medical College and Hospital, Ludhiana, Punjab, India

Corresponding Author
Dr. Shivani Gupta
Senior Resident, Department of Microbiology, Dayanand Medical College and Hospital, Ludhiana, Punjab, India
Email: shivanig507@gmail.com

ABSTRACT
Introduction: Bloodstream infection (BSI) is a serious problem in hospitals all over the world. It is defined by a positive blood culture in a patient with systemic signs of infection and may be either secondary to a documented source or primary—that is, without identified origin. It is the most common preventable cause of mortality and morbidity in critically ill patients. **Aim:** to identify the bacterial isolates from BSI in ICUs. **Methods:** The present prospective study was conducted in the Department of Microbiology for one year, in which patients admitted in ICUs with blood culture positive were included. Under all aseptic conditions ,sample was collected and processed as per standard protocolos Once the blood culture bottle flagged positive smears were prepared and sub cultured on blood agar and MacConkey's agar plates and incubated at 37°C for 18-24 hours. Identification and sensitivity of the organisms was done by using VITEK 2 system. **Results:** Total 226 patients were positive with BSI**.** The average age of the patients enrolled was 49.7 ± 15.7 years. Majority of patients were males 73.9% and 26.1% were females. Monomicrobial growth was seen in 222(98.4％) and polymicrobial growth (two isolates each) was seen in 4(1.6％) samples which makes total of 230 bacterial isolates out of which 172 (74.8％) were Gram negative and 58(25.2％) were Gram positive isolates. Gram negative isolates were highly susceptible to amikacin and less susceptible to fluoroquinolones. Most of the Gram positive isolates were susceptible to linezolid, daptomycin, vancomycin.
Conclusion: BSI with Gram negative organisms were more than that with Gram positive organisms.
Keywords: BSI, ICU, Gram Positive, Gram Negative

INTRODUCTION

Bloodstream infection (BSI) is a serious problem in hospitals all over the world. It is defined by a positive blood culture in a patient with systemic signs of infection and can be either secondary to a documented source or primary-that is, without identified origin.[1] Globally, bloodstream infection affects about 30 million people causing around 6 million deaths in a year.[2]

The rate of BSI is more in patients admitted in the intensive care units (ICU).[3] BSI are characterized by the presence of viable microorganisms in the bloodstream that elicit inflammatory response and often accompanied by alteration of clinical, laboratory, and hemodynamic parameters.[4] Most common microorganisms causing BSI are Gram-negative bacteria such as Escherichia coli, Pseudomonas aeruginosa, Klebsiella species, Neisseria meningitidis, and Haemophilus influenzae, and among Gram-positive bacteria such as Staphylococcus aureus, Streptococcus pneumoniae, Streptococcus pyogenes, Streptococcus agalactiae, Coagulase-negative Staphylococci (CoNS), and Enterococcus faecium[5] .BSI can be primary or secondary. When microorganism isolated in the blood culture coincides with a culture from a distal source, it is known as secondary BSI whereas episodes in which there is no documented distal source are defined as BSIs of unknown origin or primary BSI.[6] Various symptoms associated with bloodstream infections include fever, chills, reduced vascular tone, low blood pressure, change in mental status, hyperventilation, hypothermia, excessive sweating. Although blood cultures remain as the best means of diagnosing bacteremia , complementary testing with antigen tests, microbiologic investigations from other body sites, and histopathology can often aid in the diagnosis of disseminated disease.[7] The present study was conducted with the aim to identify the bacterial isolates from blood samples of BSI in the ICUs.

MATERIALS AND METHODS

The present study was a prospective study conducted in the Department of Microbiology for a period of one year , in which patients admitted in ICUs with blood culture positive were included and is approved by Internal ethical committee. For each patient, only one BSI episode and, for each episode, only the first samples were considered. A BSI episode was defined as a time-period associated with one or more blood cultures positive for the same organism.[8] Under all aseptic conditions, 10-12 ml of blood was withdrawn from antecubital vein with a disposable syringe and was inoculated directly into commercially prepared BACTEC 9240 or BacT/Alert culture bottles. The samples received in the microbiology lab were processed as per standard protocols. Blood specimen was processed in the BACTEC(BD) or Bac-T/Alert(BIOMERIEUX) microbial detection system. The blood culture bottles were loaded in the instrument and incubated for a maximum period of 6 days or till the bottle was indicated positive by the system and time to positivity was noted. Smears were prepared from the positive blood culture bottles and Gram staining of the smears was done. Simultaneously the sample from all the positive bottles was sub cultured on blood agar and MacConkey's agar plates and incubated at 37°C for 18-24 hours. Growth was identified by the colony characteristics, gram staining and the VITEK 2 system. Identification and sensitivity of the organisms was done by using AST-GP628 card & AST-GN280/281 cards.

RESULTS

Majority of patients were in the age group of 51-60 years , followed by 61-70years. The average age of the patients enrolled was 49.7±15.7 years. Males were more than females.

**Table 1: age and gender wise is tribution of patients with BSI(n=226)**

Age(Years)	No. of cases	Percentage
18-20	4	1.7
21-30	23	10.2
31-40	38	16.8
41-50	37	16.4
51-60	70	31
61-70	40	17.7
71-80	8	3.5
81-90	6	2.7
Gender		
Female	59	26.1
Male	167	73.9

(Table -1) Monomicrobial growth was seen in 222 and polymicrobial growth (two isolates each) was seen in 4 samples of BSI thus total of 230 isolates were obtained from 226 blood samples. Out which 172 were Gram negative of which Klebsiella pneumoniae was the most common. 58 were Gram positive isolates of which CoNS was the most common.

Table 2: distribution of blood culture isolates (n=230)

Organism	No. of isolates	%age
Gram Negative isolates (n=172)		
Klebsiella pneumoniae	64	27.9
Acinetobacter baumannii	44	19.2
Escherichia coli	30	13.1
Pseudomonas aeruginosa	9	4
Stenotrophomonas maltophilia	5	2.3
Enterobacter cloacae	4	1.8
Acinetobacter lwoffii	3	1.3
Sphingomonas paucimobilis	3	1.3
Achromobacter xylosans	2	0.8
Salmonella typhi	2	0.8
Serratia marscenses	2	0.8
Burkholderia cepacia	1	0.4
Elizabethkingia meningoseptica	1	0.4
Proteus mirabilis	1	0.4
Pseudomonas stutzeri	1	0.4
Gram Positive isolates (n=58)		
Coagulase negative Staphylococcus	31	13.4
Staphylococcus aureus	18	7.8
Enterococcus faecium	9	3.9

(Table 2). Klebsiella pneumoniae and Escherichia isolates were highly susceptibility to amikacin whereas low susceptibility to cephalosporins and ciprofloxacin. Acinetobacter baumannii was also highly susceptible to amikacin while low susceptibility was seen to cotrimoxazole and ampicillin.
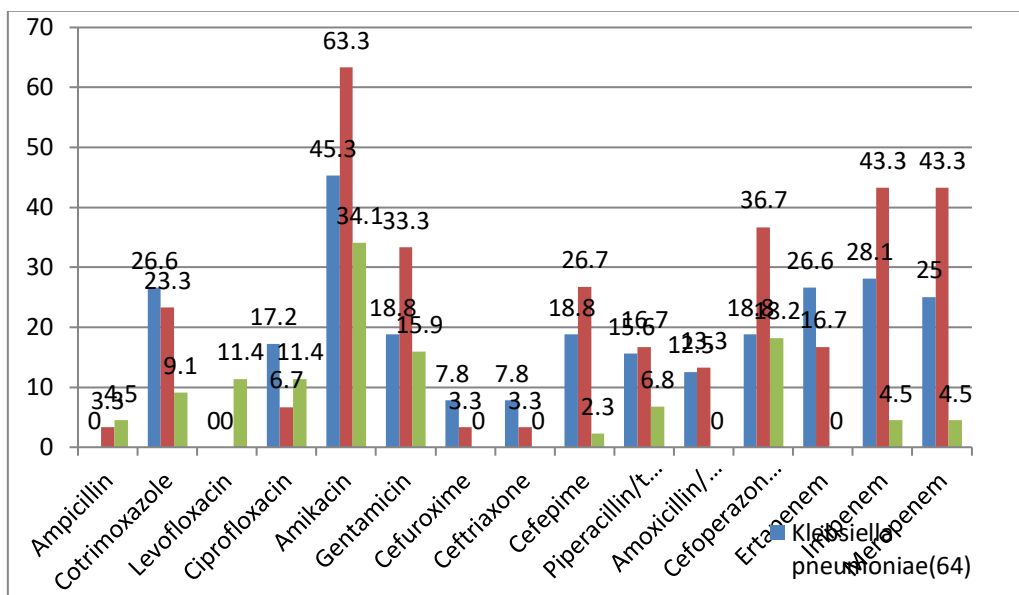
Figure 1: Antimicrobial susceptibility pattern of predominant gram negative isolates (n=172)
(Figure-1) Among CONS all isolates showed resistance to penicillin. Low susceptibility to erythromycin and fluoroquinolones and highly susceptible to vancomycin, teicoplanin and linezolid. Staphylococcus aureus all isolates showed resistance to penicillin while low susceptibility to erythromycin and high susceptibility to linezolid , teicoplanin, vancomycin.(Figure-2)
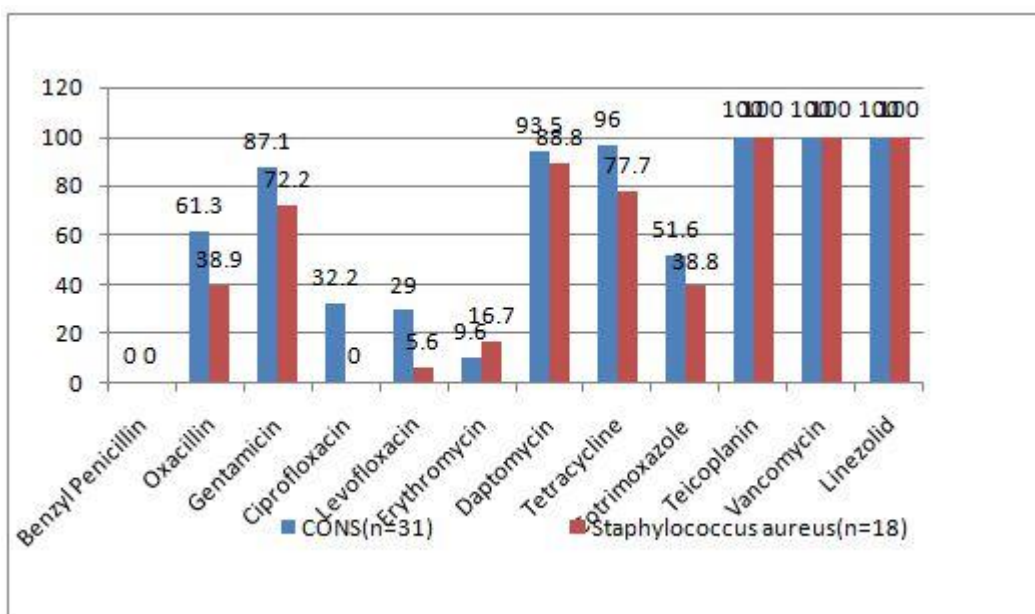
Figure 2: Antimicrobial susceptibility pattern of predominant gram positive isolates (n=58)

DISCUSSION

This prospective study was conducted over a period of one year in the department of Microbiology, in which total 226 blood culture positive samples and 230 bacterial isolates were included. In our study, majority of BSI were seen in males (73.9%) which is similar to a study made by Bhabhor Ullas et al[9] in which BSI were more in males (54.33%) , mean age of the patients having BSI was 49.7±15.7 years which

was comparable with the study of Dr. Venu Gopal et al[10] (mean age 47). In the present study monomicrobial growth was seen in (98.4%) samples and polymicrobial growth was (two isolates each) in (1.6%) samples which is similar to results shown by Mathur et al[11] in which out of 152 bacteremia episodes, 156 bacterial isolates were obtained, (97%) were monomicrobial and (3%) were polymicrobial. In the present study, primary bacteraemia was seen in

150 out of 226 BSI i.e 66.4% whereas secondary bacteraemia was seen in 76 BSI i.e 33.6% which is almost similar to rate (32% and 37%)of primary and secondary bacteraemia respectively reported by Wisplinghoff et al.[12]Our study showed that out of the 230 isolates, 172i.e 74.8% were Gram negative and 58 i.e 25.2% were Gram positive , thus showing that maximum BSI were caused by Gram negative organisms. This was in comparison with study made by Jordi Vallés et al.[13] which showed that in their study maximum BSI were caused by Gram positive organisms(55%). Our data is similar with the study made by Mehta et al.[14]in which Gram negative organisms accounted for 80.96% of BSI. In our study among the Gram negative organisms Klebsiella pneumoniae was the most commonly isolated organism(27.9%) followed by Acinetobacter baumannii (19%) and Escherichia coli(13.1%) which was also seen in study made by Orsini J et al.[15] Other Gram negative organisms isolated in our study were Pseudomonas, Stenotrophomonas, Enterobacter cloacae, Acinetobacter lwoffii, Sphingomonas paucimobilis, Achromobacter xylosans, Salmonella typhi, Serratia marscenses, Burkholderia cepacia, Elizabethkingia meningoseptica, Proteus mirabilis . In our study CoNS was the most common Gram positive organism isolated(13.4%) followed by Staphylococcus aureus (7.8%) ,this is similar to study made by Silvia Natoli et al.[16] whereas in another study made by Shaaban H. Ahmed et al.[17] Staphylococcus (29.2%,) was most common Gram positive organism isolated followed by Enterococcus(7.4%,). In our study Gram negative isolates showed low susceptibility to ampicillin (2.9%), amoxyclavulanic (10.5%), ciprofloxacin (17.4%), piperacillin / tazobactam (17.4%), gentamicin (25.5%) cefoperazone / sulbactam (27.3%), while susceptibility to amikacin was 48.8% this is almost similar to study done by S sager Faiz et al. 21[18] In our study all isolates of Staphylococcus aureus showed resistance to penicillin and ciprofloxacin while high susceptibility was shown to gentamicin(72.2%), linezolid (72.2%), tetracyclines (77.7%), teicoplanin (83.3%), daptomycin (88.8%) and 100% isolates were vancomycin sensitive. Among CONS all isolates showed resistance to penicillin. Low susceptibility was seen to erythromycin (9.6%), clindamycin (12.9%) and susceptibility to fluoroquinolones was almost 25%. All CONS were susceptible to vancomycin, teicoplanin and linezolid (100%) which is comparable with similar study of R.B. Patwardhan et al,[19]

Thus in our study Gram positive isolates showed high susceptibility to vancomycin, teicoplanIn and linezolid. To conclude BSI with Gram negative organisms are more than with Gram positive organisms and are more in ICUs as patients admitted in ICUs are generally immunocompromised which leads to more morbidity and mortality of patients.

CONFLICT OF INTEREST
None

SOURCES OF FUNDING
None

REFERENCES
1. Timsit JF, Ruppé E, Barbier F, Tabah A, Bassetti M. Bloodstream infections in critically ill patients: an expert statement. Intensive Care Med. 2020;46(2):266-84.
2. Ershova K, Savin I, Kurdyumova N, Wong D, Danilov G, Shifrin M et al. Implementing an infection control and prevention program decreases the incidence of healthcare-associated infections and antibiotic resistance in a Russian neuro-ICU. Antimicrob Resist Infect Control. 2018;7:94.
3. Bryan CS, Hornung CA, Reynolds KL, Brenner ER. Endemic bacteremia in Columbia, South Carolina. Am J Epidemiol. 1986;123(1):113-27.
4. Viscoli C. Bloodstream Infections: The peak of the iceberg. Virulence. 2016;7(3):248-51.
5. Dagnew M, Yismaw G, Gizachew M, Gadisa A, Abebe T, Tadesse T et al. Bacterial profile and antimicrobial susceptibility pattern in septicemia suspected patients attending Gondar University Hospital, Northwest Ethiopia. BMC Res Notes. 2013;6:283.
6. Friedman ND, Kaye KS, Stout JE, McGarry SA, Trivette SL, Briggs JP et al. Health care associated bloodstream infections in adults: a reason to change the accepted definition of community-acquired infections. Ann Intern Med. 2002;137(10):791-7.
7. Martinez RM, Wolk DM. Bloodstream Infections. Microbiol Spectr. 2016 Aug;4(4).
8. Leli C, Ferranti M, Moretti A, Al Dhahab ZS, Cenci E, Mencacci A.Procalcitoninlevelsingram-positive,gram-negative,andfungalbloodstreaminfections.DisMarkers.2015;2015:701480.
9. Bhabhor U, Bhabhor H, Shingala H, Sinha M. Bacteriological study of blood stream infection (BSI) in ICU patients. Indian Journal of Microbiology Research. 2018;5(3):368-73.
10. Venu Gopal L. A Study of foci of infection on admission in patients with sepsis in Multidisciplinary Intensive Care Unit (Doctoral dissertation).
11. Mathur P, Kapil A, Das B. Nosocomial bacteraemia in intensive care unit patients of a tertiary care centre. Indian J Med Res. 2005;122(4):305-8.
12. Wisplinghoff H, Bischoff T, Tallent SM, Seifert H, Wenzel RP, Edmond MB. Nosocomial bloodstream infections in US hospitals: analysis of 24,179 cases from a prospective nationwide surveillance study. Clin Infect Dis. 2004;39(3):309-17.
13. Vallés J, Rello J, Ochagavía A, Garnacho J, Alcalá MA. Community- acquired bloodstream infection in critically ill adult patients: impact of shock and inappropriate antibiotic therapy on survival. Chest. 2003;123(5):1615-24.
14. Mehta M, Dutta P, Gupta V. Antimicrobial susceptibility pattern of blood isolates from a teaching hospital in north India. Jpn J Infect Dis. 2005;58(3):174-6.

945

15. Orsini J, Mainardi C, Muzylo E, Karki N, Cohen N, Sakoulas G. Microbiological profile of organisms causing bloodstream infection in critically ill patients. J Clin Med Res. 2012;4(6):371-7.

16. Natoli S, Fontana C, Favaro M, Bergamini A, Testore GP, Minelli S, et al. Characterization of coagulase-negative staphylococcal isolates from blood with reduced susceptibility to glycopeptides and therapeutic options. BMC Infect Dis. 2009;9:83.

17. Ahmed SH, Daef EA, Badary MS, Mahmoud MA, AbdElsayed AA. Nosocomial blood stream infection in intensive care units at Assiut University Hospitals (Upper Egypt) with special reference to extended spectrum β- lactamase producing organisms. BMC research notes. 2009;2(1):76

18. Saghir S, Faiz M, Saleem M, Younus A, Aziz H. Characterization and anti-microbial susceptibility of gram-negative bacteria isolated from bloodstream infections of cancer patients on chemotherapy in Pakistan.Indian J Med Microbiol. 2009;27(4):341-7.

19. Patwardhan RB, Dhakephalkar PK, Niphadkar KB, Chopade BA. A study on nosocomial pathogens in ICU with special reference to multiresistant Acinetobacter baumannii harbouring multiple plasmids. Indian J Med Res. 2008;128(2):178-87.