e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(12); 910-914

Original Research Article

Determining the Causative Agent and Associated Antimicrobial Resistance in Central Line-Associated Blood Stream Infections from Patients Admitted In ICU

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Received: 08-10-2023 / Revised: 15-11-2023 / Accepted: 20-12-2023
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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to assess the incidence, bacteriological profile and antimicrobial susceptibility pattern of the isolates in CLABSI in the Intensive Care Unit (ICU) patients.

Methods: This prospective study was conducted in the Department of Microbiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India for the period of one year (feb 2018 to jan 2019). A total of 448 patients were included in the study.

Results: Maximum patients (67%) were less than 50 years of age followed by 51-64 years (16%). Out of which 329 were males and 119 were females. Maximum patients (22) who developed CLABSI were under the age group of less than 50 years followed by 51-64 years of age. 306(68%) were on Central line catheter and CLABSI was diagnosed in 27(6.02%). The total Central line device days were 1520 and the CLABSI incidence rate was 17.76. Among gram-negative bacilli, Acinetobacter sp. (1.56%) was the common organism isolated followed by Klebsiella sp. (0.89%) followed by Pseudomonas sp. and Citrobacter sp. (0.67%). Among gram-positive cocci, Staphylococcus aureus (1.34%) was the common organism isolated followed by Enterococcus sp. (0.44%) and Methicillin-resistant Staphylococcus aureus (0.44%).

Conclusion: CLABSI is a highly prevalent problem in the intensive care unit. One of the significant reasons for central line removal is an infection or suspicion. This clinical practice leads to prolonged hospital stays and increased procedures and complication rates. One of the challenges with central lines is the variety of catheter types inserted by diverse staff which are sometimes undertrained.

Keywords: Anti-Microbial Resistance, Central Line-Associated Bloodstream Infection, Intensive Care Unit, Medical Devices

Introduction

Bloodstream infections, estimated to occur in 10-25% of oncology patients, are a substantial cause of serious morbidity in this patient population. [1] Neutropenia and gastrointestinal mucosal damage resulting from cytotoxic cancer therapies, as well as the frequent use of central venous catheters, are significant risk factors for bloodstream infections originating from endogenous colonic and/or skin flora. [2,3] Preventing bloodstream infections and associated complications is therefore a critical patient safety issue and has motivated the creation of clinical practice guidelines for antibiotic prophylaxis and empiric treatment of neutropenic cancer patients with fever. [1]

These guidelines refer to nationwide epidemiologic data to direct specific antimicrobial regimens towards the most common pathogens isolates from in oncology patients. [1,4] However, the referenced data are from over 15 years ago, and there has since been no other large-scale survey of cancer-associated bloodstream infections in the United States. [4] In the last 10-15 years, the landscape of antimicrobial resistance has changed substantially for all patient care in the United States. Methicillin-resistant Staphylococcus aureus emerged as a significant pathogen in the community; and resistant gram-negative organisms, including extended spectrum β-lactamase- (ESBL) producing, carbapenem-resistant and fluoroquinolone-resistant

Enterobacteriaceae are increasingly viewed as major threats. [5-9]

In addition to these overall trends in antimicrobial resistance, oncology patient populations might be uniquely and more severely affected by emerging antimicrobial-resistant threats. For example, although prophylactic use of fluoroquinolones in high-risk neutropenic patients has been reported to decrease bloodstream infections [10], hospitalizations [11] and mortality [12] and has been recommended in professional society guidelines [1,13], significant concerns have been raised about selection of antimicrobial-resistant organisms in conjunction with this practice. [14,15] Pseudomonas infection is commonly seen in association with neutropenia, severe illness, or known prior colonization. Certain bacteria such as staphylococci and pseudomonas produce an extracellular polysaccharide layer [slime (biofilm)], which favours increased virulence, adherence to catheter surface, and resistance to antimicrobial therapy.

The aim of the present study was to assess the incidence, bacteriological profile and antimicrobial susceptibility pattern of the isolates in CLABSI in the Intensive Care Unit (ICU) patients.

Materials and Methods

This prospective study was conducted in the Department of Microbiology ,Anugrah Narayan Magadh Medical College, Gaya, Bihar, India for the period of one year(feb 2018 to jan 2019). A total of 448 patients were included in the study.

Inclusion criteria were Informed consent of patients admitted to the ICU for more than 48 hours with a Central line catheter. Exclusion criteria were OPD patients and patients without Central line catheters. Patients showing clinical signs of infection on or before admission or transfer to the ICUs were not included in the study and Refusal of consent.

After taking informed consent, detailed history including the name, age, sex, underlying clinical condition, date of admission to the ICU, any history of previous antibiotic intake, the treatment being administered in the ICU, and clinical outcome of each patient. Laboratory samples for CLABSI were taken depending on the clinical suspicion from the patients admitted to the ICU for more than 48 hrs. All specimens were collected as per standard aseptic protocol and transported to the laboratory as early as possible. Gram staining was made from all specimens and examined to determine the presence, type of cells, relative number of microorganisms and their morphologies. All the samples were inoculated on Blood agar and MacConkey agar. Incubate Blood and MacConkey agar at 37°C overnight.

In case of significant growth, the isolated colonies were subjected to gram staining, antibiotic sensitivity test (Kirby-Bauer Disk Diffusion Method) and biochemical tests for identification as per established Departmental protocols. The identification of organisms was done with biochemical tests. The organism was reported as sensitive, intermediate or resistant based on the standard zone size. The following antibiotic discs with their respective concentrations were used: ampicillin(AMP) (10 µg), gentamicin(GEN) (10 µg), ciprofloxacin(CIP) (5 µg), tetracycline(TEC) (30 µg), erythromycin (15 µg), vancomycin (30 µg), chloramphenicol (30 µg), norfloxacin (10 µg), nitrofurantoin (300 µg), cefoxitin (30 µg), and ceftriaxone (30 µg) for Gram positive bacteria and ampicillin (10 µg), piperacillin (100 µg), cefoxitin (30 µg), Cefepime (30 µg), ceftriaxone (5 µg), gentamicin (10 µg), ciprofloxacin (5 µg), tetracycline(TET) (30 µg), meropenem(MRP) (10 µg), amikacin(AMK) (30 µg), nitrofurantoin(NIT) (300 µg) and ceftazidime(CAZ) (30 µg) for Gram-negative bacteria.

Results

Table 1: Age and gender distribution of patients

AGE(yrs)	Total no. of patients
≤50	301(67%)
51–64	71(16%)
65–79	58(13%)
≥80	18(4%)
Gender	
Male	329 (73.43)
Female	119 (26.57)

Maximum patients (67%) were less than 50 years of age followed by 51-64 years (16%). Out of which 329 were males and 119 were females.

Table 2: Age distribution of patients with CLABSI

Age(years)	CLABSI
≤50	22
51–64	4
65–79	1

Maximum patients (22) who developed CLABSI were under the age group of less than 50 years followed by 51-64 years of age.

Table 3: CLABSI incidence rate among patients admitted to ICU

Total no. of patients on the central line	306
Total no. of central line days	1520
No. of CLABSI	27
CLABSI incidence rate: No. of CLABSI/no. of central line days ×1000	17.76

306(68%) were on Central line catheter and CLABSI was diagnosed in 27(6.02%). The total Central line device days were 1520 and the CLABSI incidence rate was 17.76.

Table 4: Type and the total number of organisms isolate in CLABSI

Organism	Number
Staphylococcus aureus	6
Methicillin-resistant Staphylococcus aureus (MRSA)	2
Acinetobacter sp.	7
Pseudomonas sp.	3
Klebsiella sp.	4
Enterococcus sp.	2
Citrobacter sp.	3
Total	27

Among gram-negative bacilli, Acinetobacter sp. (1.56%) was the common organism isolated followed by Klebsiella sp. (0.89%) followed by Pseudomonas sp. and Citrobacter sp. (0.67%). Among gram-positive cocci, Staphylococcus aureus (1.34%) was the common organism isolated followed by Enterococcus sp. (0.44%) and Methicillin-resistant Staphylococcus aureus (0.44%).

Discussion

CLABSI is the presence of bacteremia originating from a central line catheter. [17] CLABSI is a common cause of healthcare-associated infection and is a major cause of morbidity and mortality. Central venous catheters (CVCs) are associated with a greater risk of device-related infections as compared to any other medical device. [18] The diagnosis of CLABSI is confirmed by isolation of the same microorganism from the catheter tip and at least one blood culture, with the presence of clinical manifestations of infection and no other detectable source of infection. [19] The patient must have at least one of the following features: fever (temperature≥38 degrees Celsius), chills, or hypotension. Central venous catheters (CVC) are being used with increasing frequency in hospitals both in an ICU as well as outside ICUs. According to the Centre for Disease Control and Prevention-National Healthcare Safety Network- 2013 report, the mean incidence of CLABSI per 1000 central line days was found as 0- 2.9% in critical care units and 0-1.2% in inpatient wards. [20]

Maximum patients (67%) were less than 50 years of age followed by 51-64 years (16%). Out of which 329 were males and 119 were females. Maximum patients (22) who developed CLABSI were under the age group of less than 50 years followed by 51-64 years of age. 306(68%) were on Central line catheter and CLABSI was diagnosed in 27(6.02%). The total Central line device days were 1520 and the CLABSI incidence rate was 17.76. Sundaram GVG et al., 2020 [21] and Yoshida Tet al., 2019. [22] The samples were collected during the whole study. Out of 448 patients, 306 have central lines. Out of 306 patients, 140 develop symptoms related to device-associated infections. The samples of all 140 patients were collected and processed. Among 140 patients 27 developed central line associated bloodstream infection. The CLABSI rate was calculated. The formula for CLABSI Rate used wasCLABSI incidence rate which was calculated as no. of CLABSI / no. of central line days × 1000. The CLABSI rate found was 17.76 per 1000 catheter days. This formula was also used in the studies of Salama MF et al., 2016 [23] and Sun et al., 2020. [24]

Among gram-negative bacilli, Acinetobacter sp. (1.56%) was the common organism isolated

followed by Klebsiella sp. (0.89%) followed by Pseudomonas sp. and Citrobacter sp. (0.67%). Among gram-positive cocci, Staphylococcus aureus (1.34%) was the common organism isolated followed by Enterococcus sp. (0.44%) and Methicillin-resistant Staphylococcus aureus (0.44%). In another study which was done by SeeIet al.,2016 [25] the highest overall prevalence of antimicrobial resistance was found in Enterococcus faecium (82.5% vancomycin- resistant), Escherichia coli (56.5% fluoroquinolone- resistant), and Staphylococcus aureus (45.6% methicillin-resistant). Carbapenem resistance was uncommon among Escherichia Coli and Klebsiella species (0.4% and 4.6%, respectively).

Conclusion

CLABSI is a highly prevalent problem in the intensive care unit. One of the significant reasons for central line removal is an infection or suspicion. This clinical practice leads to prolonged hospital stays and increased procedures and complication rates. One of the challenges with central lines is the variety of catheter types inserted by diverse staff which are sometimes undertrained.

References

1. reifeld AG, Bow EJ, Sepkowitz KA, et al. Clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. Clin Infect Dis. 2 011;52:e56–e93.
2. Kamboj M, Sepkowitz KA. Nosocomial infections in patients with cancer. Lancet Oncol. 2009;10:589–597.
3. Maschmeyer G, Haas A. The epidemiology and treatment of infections in cancer patients. Int J Antimicrob Agents. 2008;31:193–197.
4. Wisplinghoff H, Seifert H, Wenzel RP, Edmond MB. Current trends in the epidemiology of nosocomial bloodstream infections in patients with hematological malignancies and solid neoplasms in hospitals in the United States. Clin Infect Dis. 2003;36: 1103–1110.
5. Pitout JDD, Laupland KB. Extended-spectrum β-lactamase-producing Enterobacteriaceae: an emerging public-health concern. Lancet Infect Dis. 2008;8:159–166.
6. Fridkin SK, Hageman JC, Morrison M, et al. Methicillin-resistant Staphylococcus aureus disease in three communities. New Engl J Med . 2005;352:1463–44.
7. Klevens RM, Morrison MA, Nadle J, et al. Invasive methicillin-resistant Staphylococcus aureus infections in the United States. JAMA. 2007;298:1763–71.
8. Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States. 2013.
9. Centers for Disease Control and Prevention. Vital signs: carbapenem-resistant Enterobact eriaceae. MMWR. 2013;62:165–70.
10. Bucaneve G, Micozzi A, Menichetti F, et al. Levofloxacin to prevent bacterial infection in patients with cancer and neutropenia. New Engl J Med. 2005;353:977–987.
11. Cullen M, Steven N, Billingham L, et al. Antibacterial prophylaxis after chemotherapy for solid tumors and lymphomas. New Engl J Med. 2005;353:988–998.
12. Gafter-Gvili A, Fraser A, Paul M, Leibovici L. Meta-analysis: antibiotic prophylaxis reduces mortality in neutropenic patients. Annals Int Med. 2005;142:979–995.
13. Flowers CR, Seidenfeld J, Bow EJ, et al. Antimicrobial prophylaxis and outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology clinical practice guideline. J Clin Onc. 2013;31:794–810.
14. Hammond SP, Baden LR. Antibiotic prophylaxis for patients with acute leukemia. Leuk Lymphoma. 2008;49:183–193.
15. Bow EJ. Fluoroquinolones, antimicrobial resistance and neutropenic cancer patients. Curr Opin Infect Dis. 2011;24:545–553.
16. Bell T and O'Grady NP. Prevention of Central Line-Associated Bloodstream Infections. Infect Dis Clin North Am. 2017 Sep;31(3):551-559.
17. Miller LM, Clark E, Dipchand C, Hiremath S, Kappel J, Kiaii M, et al. Canadian Society of Nephrology Vascular Access Work Group. Hemodialysis Tunneled Catheter-Related Infections. Can J Kidney Health Dis. 2016 Sep 27; 3:2054358116669129.
18. Merzel LA. Prevention of intravascular catheter- related infections. Ann Intern Med 20 00; 132:391–402.
19. Saxena AK and Panhotra BR. Haemodialysis catheter-related bloodstream infections: current treatment options and strategies for prevention. Swiss Med Wkly. 2005; 135(9 -10):127–38.
20. Dudeck MA, Edwards JR, Allen-Bridson K, Gross C, Malpiedi PJ, Peterson KD, Pollock DA et al. National Healthcare Safety Network report, data summary for 2013, Device-associated Module. Am J Infect Control. 2015 Mar 1;43(3):206-21.
21. Soundaram GVG, Sundaramurthy R, Jeyashree K, Ganesan V, Arunagiri R, Charles J. Impact of Care Bundle Implementation on Incidence ofCatheter- associated Urinary Tract Infection: A ComparativeStudy in the Intensive Care Units of a Tertiary Care TeachingHospital in South India. Indian J Crit Care Med 2020; 24 (7):544–550. .
22. Yoshida T, Silva AEBC, Simões LLP, Guimarães RA. Incidence of Central Venous Catheter-Related Bloodstream Infections:

Evaluation of Bundle Prevention in Two Intensive Care Units in Central Brazil. Scientific World Journal. 2019 Oct 7; 2019:10 25-032.
23. Salama MF, Jamal W, Mousa HAI, Rotimib V. Implementation of central venous catheter bundle in an intensive care unit in Kuwait: Effect on centralline-associated bloodstream infections. Journal of Infection and Public Health 2016; 9:34-41.
24. Sun Y, Bao Z, Guo Y, Yuan X. Positive effect of care bundles on patients with central venous catheter insertions at a tertiary hospital inBeijing, China. Journal of International Medical Research 2020; 48(7):1–10.
25. See I, Freifeld AG, Magill SS. Causative Organisms and Associated Antimicrobial Resistance in Healthcare-Associated Central Line-Associated Bloodstream Infections from Oncology Settings, 2009–2012. Clin Infect Dis. 2016 May 15; 62(10):1203–1209.