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Original Research Article

Prevalence and Antimicrobial Sensitivity Pattern of Central Line Associated Blood Stream Infections in a Tertiary Care Hospital: Need for Continuous Quality Improvement

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Abstract

Background: It is a well-known fact that regular training of the healthcare workers keeps their morale high and motivates them to indulge themselves in infection control practices.

Purpose: This study was undertaken to find out the impact of training on central lines associated bloodstream infection rates. This study was conducted in a tertiary care hospital; it included all the patients on central line.

Method: Lab confirmed bloodstream infection cases were obtained from Microbiology lab. Central lines associated bloodstream infections were deduce after follow up. Rates were calculated as per CDC guidelines. Organisms included were further evaluated for identification and their sensitivity.

Results: The rate before training was 4.2/1000 catheter days which reduced to 2.91/1000 catheter days. *Klebsiella pneumoniae* was the most common isolate which was sensitive to polymixin B (100%) and colistin (97%) only. 3% of isolates were harbouring *K. pneumonia* carbapenemases enzymes.

Conclusion: This study shows that regular educational programme is important to bring out behavioral change among staff and sensitivity of these nosocomial isolates if shared with nursing staff might act as an eye opener for these staffs.

Keywords: Central line associated blood stream infections, hospital acquired infection, multidrug resistant organism.

Introduction

Central line associated blood stream infection (CLABSI) is defined as a laboratory-confirmed bloodstream infection (LCBSI) where a microorganism is identified, and central line is present on the LCBSI date of event or the day before [1]. It is used for surveillance and infection control purpose. Incidence is more in developing countries whereas developed countries it is at lower rate. Infection control practices play a major role in decreasing the rate. The more the compliance to infection control practices at any hospital, the lesser is the rate [2]. Increase rate can be attributed to lack of resources, frequent attrition, trained staff

and un-favorable nurse patient ratio [1,2,3]. It is also important to know the organisms isolated from CLABSI cases and their sensitivity pattern. Knowing bacterial flora and sensitivity would help clinicians in starting empirical therapy and nursing staff would know the prevalence of organisms. The incidence of CLABSI is more in ICUs due to emergency catheter placement, longer duration and repeated manipulation for sampling, administration of drugs and fluids; the additional confounding factors being chronic illness, old age, sepsis and immunosuppression. [4]

It is well known that CLABSI is generally due to multidrug resistant organisms (MDROs). These organisms are notorious and difficult to manage on routine treatment. Patient once infected with these MDROs lands into sepsis and septic shock. These infections lead to increase cost due to increase length of stay in critical care units, increase mortality. If patient recovers from sepsis, there remains certain loss of function (morbidity) [5]. Regular training has been associated with increase compliance and decrease infection rates [6]. Educating healthcare workers and following multi-dimentional approach has been key factors in reducing CLABSI [7,8]

With the aim of implementation of best infection control practices at our hospital this study was undertaken to find out the role of continuous training of nursing staff towards infusion practices and rate of CLABSI in surveillance studies and also find the etiology and antimicrobial susceptibility pattern.

2. Material and Methods

2.1 Sample collection

As per hospital policy blood culture (1set) from 2 different sites were obtained. Training on blood sample collection for culture was given to all the nursing staff to obtain 16-20ml of blood from each individual.

2.2 Inclusion Criteria

All the patients with positive blood culture (either of the bottle with organism known for causing sepsis) and having central line in place and meeting the CDC criteria for CLABSI were included in the study. [8].

2.3 Exclusion criteria

- Infants with secondary infections
- Positive blood culture interpreted as contaminant (positive blood culture in only 1 out of 2 blood cultures growing contaminants) [9]
- Positive blood culture not fulfilling CDC criteria for CLABSI
- Patients with peripheral line along with central line.

2.4 NHSN Criteria for CLABSI

- Exposure to the central line catheter for more than 48 hours.
- Laboratory-confirmed bloodstream infection (BSI).
- More than equal to one blood culture positive for recognized pathogen.
- More than equal to two blood culture positive for common commensal with any one of the signs: fever, hypotension, or bradycardia.
- No evidence of infection of the any other site of the body caused by the same organism during that time frame period (3 days before and 14 days after the day of event).

2.5 Bundle Implementation

A series of sessions comprising of basic infection control practices with emphasis on clinical practice guidelines on prevention of CLABSI were conducted from the month of June 2018 to August 2018. They were trained on insertion and maintenance bundle components. The department of Infection control used to collect both the bundles forms for analysis.

2.6 Sample processing

All the Blood cultures received in the Microbiology lab were then incubated in automated blood culture system (BD,

BACTEC). A gram stain was performed on all the positive samples and simultaneously sub-culture was done on Mac-Conkey Agar (Oxoid) and Blood Agar (BD). Growth was subjected to identification and sensitivity in automated system; Vitek 2C (Biomereiux). The positive blood cultures were immediately informed to the respected department by the technicians. The sensitivity obtained was shared next day to the consultants in charge. The patient's whose blood sample was flagged positive by the automated blood culture system was informed immediately to infection control department for further evaluation. In the wards/ICU the Infection control nurse (ICN) used to check whether the sample meets the criteria for CLABSI.

2.7 Collection of data

Before start of the study a baseline CLABSI cases and CLABSI rate/1000 device days were obtained. To find out the effect of training post 1 year, 2-year, 3 year all the annual CLABSI cases and CLABSI rate/1000 device were compared. This study therefore also included data of subsequent years to find out the effect on CLABSI rates post 2 years of training.

2.8 CLABSI Rate

Total number of CLABSI/Total number of central-line catheter day's × 1000

2.9 Antimicrobial sensitivity pattern

All the isolates obtained from 2018 to 2021 were analyzed.

3. Result

Data was collected retrospectively from Microbiology Department for LCBSI cases obtained in the year 2018 (pre training), and retrospectively 2019-2021 (post training). From these LCBSI cases the number of cases on central line and fulfilling the criteria for CLABSI were retrieved from Infection Control Information System. Data before intervention (2018) and after intervention along with next two years post intervention (2018, 2019,2021) is shown in Table 1.

Table 1 showing LCBSI[*] and CLABSI[†] cases

Timepoint	Baseline (before intervention) 2018	Immediately after completion of training, 2019	1 year after completion of training, 2020	2 years after completion of training, 2021	Average
No. of Lab confirmed BSI	298	232	169	276	243.75
No of cases with central line	64	47	71	72	63.5
No. of CLABSI cases	37	15	32	21	26.25
Catheter Rate	4.2	2.91	3.54	3.63	3.17

[*]**Lab confirmed Blood stream Infection**

[†]**Central Line Associated Blood Stream Infection**

It was found that CLABSI rate was 4.2/1000 catheter days in 2018 before the intervention. After continuous training, there was a decrease in the rate to 2.91/1000 catheter days immediately next

year. Another major observation made in this study was an increase in infection rates subsequently as shown in Table1.

Organisms obtained in these cases were analyzed for sensitivity. A total number of 103 isolates were obtained which fitted in the criteria for CLABSI cases. Distribution of isolates obtained over the entire period of the study is depicted in Figure 1. The study showed high prevalence of *K. pneumoniae* (32%), followed by *Escherichia coli* (17 %) among Gram negatives. Among Gram positives *Enterococcus sp* (14%) was more prevalent than *Staphylococcus aureus* (9%).

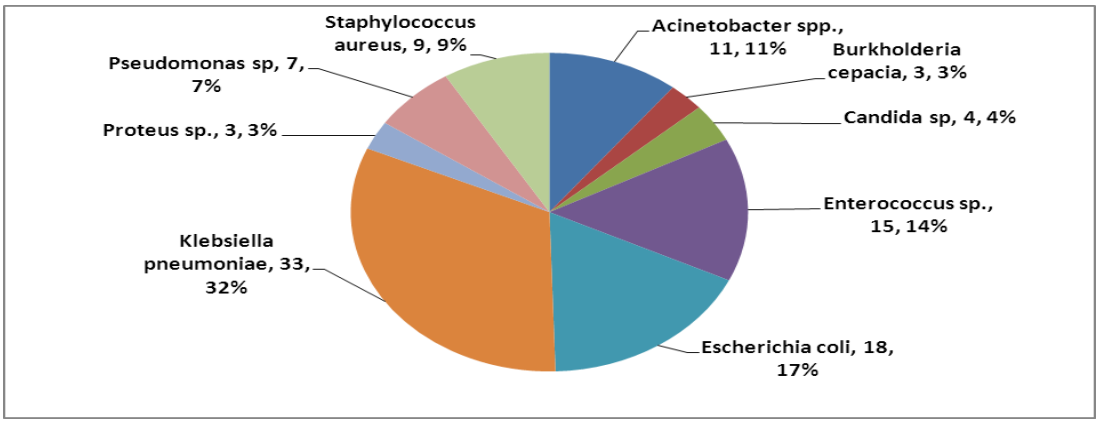

Figure 1: Showing distribution of isolates.

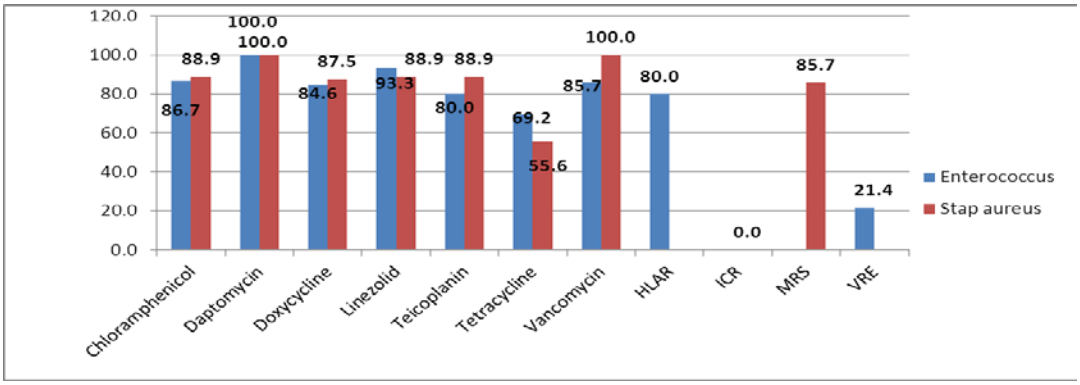

Figure 2: Showing sensitivity of Gram-Positive isolates

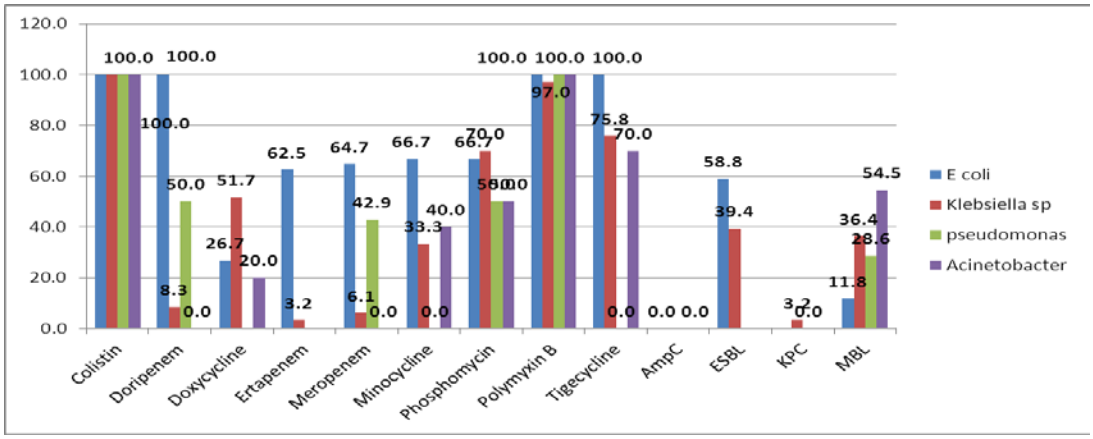

Figure 3: Showing sensitivity of Gram-negative isolates

The sensitivity of these isolates is shown in Figure 2 and Figure 3 for Gram positive and Gram-Negative isolates. The prevalence of Methicillin Resistant

Staphylococcus aureus (MRSA), High level aminoglycoside resistance (HLAR) and Vancomycin resistant Enterococcus (VRE) is depicted in Figure 2 and Figure 3 along with the sensitivity. It is found that prevalence of MRSA is 80% and prevalence of VRE is 21.4%.

The prevalence of resistant enzymes; Extended Spectrum Beta Lactamases, Metallo Beta Lactamases, *K. pneumonia* Carbapenames (ESBL, MBL, and KPC) and production of AmpC is also depicted in Figure 7 along with sensitivity of Gram-Negative bacteria.

The enzyme ESBL is prevalent in *Escherichia coli* (58.8%) and *K. pneumoniae* (39.4%) The MBL is prevalent more in *Acinetobacter sp* (54.5%) followed by *K. pneumoniae* (36.4%) and *Pseudomonas sp*. KPC is prevalent only in *K. pneumoniae* (3.2%). From figure 6 it is clear that both *S. aureus* and *Enterococcus sp* have good sensitivity to vancomycin, teicoplanin, daptomycin, linezolid. Among Gram negatives the prevalence of resistance is more in *K. pneumoniae*. And it is also evident from the figure that pan drug resistance is seen in 3% of *K. pneumonia* infection.

Discussion

The observations made in this study are that the use of standardized care practices that included CLABSI bundles and checklist during and within a year of training improved overall compliance with decrease in CLABSI rate similar to the study done by Acharya R and Mohapatra S. [10,11,12] The second major observation was data analysis after year one and year 2 of training. This was a major breakthrough which showed decrease in compliance and increased in rate. The published literature suggests that regular training forms the core in implementation of best infection control practices. The attrition rate among nursing staff can be a reason for decrease compliance and reenforces the concept of training and re trainings. [13,14]

Compliance was tracked through strict data collection, monitoring and auditing system.The CLABSI rate varies considerably in the different studies reported from India. Mehta and Rosenthal reported the incidence of CLABSI rate as 7.92/1,000 device days in India in 2007. While the study conducted by Singh et al. reported a CLABSI rate of 0.48 per 1,000 central line (CL) days, other studies showed CLABSI rates of 27.0 and 16.0 per 1,000 CL days [15-17]. The rate of this study is ranging from 2.91/1000 catheter days to 4.2/1000 catheter days/1000 catheter days. This rate is comparable to study done by Mehta et al in Indian cities [18]. The rates from Colombian hospital in a study done by Victor Rosenthal and Moreno *et al* were higher as compared to our study. [19] According to the International Nosocomial Infection Control Consortium (INICC) report for DAIs in 503 ICUs in low- and middle-income countries, the incidence density for CLABSI, per 1000 device-days was 4.78. [20]

Therefore, with this study it is substantiated that regular training decreases infection rates and increases compliance as similar to other studies. [21,22] We also included the organisms responsible for causing CLABSI along with their sensitivity pattern. This was done to find out the profile of organisms prevalent in our hospital facility. Among the organisms isolated; Gram Negative bacteria (73%) was more prevalent as compared to Gram positive (23%). Prevalence of Candida sp was also noted in small subclass (4%). A study conducted in eastern India teaching hospital showed the prevalence of *K. pneumoniae* (24.6%) similar to this study. [2,23] These organisms were resistant isolates and same is published in other studies. Various other studies have shown the association of

MDROs in HAI-CLABSI as in this hospital. [2,23,24,25]

Conclusion

This study concludes with strong message of high quality ongoing regular training of healthcare workers on hand hygiene, CLABSI Bundles, regular surveillance of catheter line insertion and maintenance practices by ICNs. This helps in implementation of best infection control practices and HAI-CLABSI can be reduced. During the training period and immediately after the training there was an increase in the compliance rate with respect to insertion and maintenance bundles and other components and hence decrease in CLABSI rate/1000 catheter days.

This study also undertook the prevalence of isolates and their sensitivity which proves time and again that these nosocomial organisms are MDR and difficult to treat. These lead to increase length of stay and cost.

Limitation

The length of stay and cost of the CLABSI cases were not included in this study.

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References

1. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections, 2011. Centers for Disease Control and Infection website. www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf. Updated April 1, 2011. Accessed Jan. 6, 2017.
2. Singhal T, Shah S, Thakkar P, Naik R. The incidence, aetiology and antimicrobial susceptibility of central line-associated bloodstream infections in intensive care unit patients at a private tertiary care hospital in Mumbai, India. Indian J Med Microbiol.,2019;37:521-6.
3. Gopal PB. The Clasp of CLABSI. Indian J Crit Care Med 2020;24(1):3–5.
4. Centers for Disease Control and Prevention (CDC). Vital signs: central line-associated blood stream infections--United States, 2001, 2008, and 2009. MMWR Morb Mortal Wkly Rep. 2011: 4;60(8):243-8.
5. Wirtschafter DD, Pettit J, Kurtin P, Dalsey M, ChanceK, Morrow HW, et al. A statewide quality improvement collaborative to reduce neonatal central line associated blood stream infections. J Perinatol. 2010; 30:170-81.
6. Barrasa-Villar JI, Aibar-Remon C, Prieto-Andrés P, Mareca-Doñate R, Moliner-Lahoz J. Impact on Morbidity, Mortality, and Length of Stay of Hospital-Acquired Infections by Resistant Microorganisms. Clin Infect Dis. 2017: 15; 65(4):644-652.
7. Rosenthal VD, Al-Abdely HM, El-Kholy AA, AlKhawaja SAA, Leblebicioglu H, Mehta Y, et al International Nosocomial Infection Control Consortium report data summary of 50 counties for 2010-2015: Device-associated module Am J Infect Control. 2016 44(12):1495-1504.
8. CDC's. Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011. Available at: https://www.cdc.gov/infectioncontrol/pdf/guidelines/bsi-guidelines-H.pdf.
9. Lamy B, Roy P, Carret G, Flandrois JP, Delignette-Muller ML. What is the relevance of obtaining multiple blood samples for culture? A comprehensive model to optimize the strategy for diagnosing bacteremia. Clin Infect Dis.2002; 35:842–50
10. Acharya R, Bedanta Mishra S, Ipsita S, Azim A. Impact of Nursing Education on CLABSI Rates: An Experience from a Tertiary Care Hospital in Eastern India. Indian J Crit Care Med. 2019;23(7):316-319.

11. Mohapatra S, Kapil A, Suri A, Pandia MP, Bhatia R, Borkar S, Dube SK, Jagdevan A, George S, Varghese B, Dabral J. Impact of Continuous Education and Training in Reduction of Central Line-associated Bloodstream Infection in Neurointensive Care Unit. Indian J Crit Care Med. 2020; 24(6):414-417.
12. Shimoyama Y, Umegaki O, Agui T, Kadono N, Komasawa N, Minami T. An educational program for decreasing catheter-related bloodstream infections in intensive care units: a pre- and post-intervention observational study. JA Clin Rep. 2017; 3(1):23.
13. Elizabeth Monsees, Paul Bauer, Yolanda Ballam, Brian Lee. Identifying Structural Factors Associated with Central Line-Associated Bloodstream Infections (CLABSI) Risk in a Single-Center Pediatric Academic Hospital. Open Forum Infect Dis. 2017 Fall; 4(Suppl 1): S635.
14. Gopal PB. The Clasp of CLABSI. Indian J Crit Care Med. 2020 Jan;24(1):3-5.
15. Singh S, Pandya Y, Patel R, Paliwal M, Wilson A, Trivedi S. Surveillance of device-associated infections at a teaching hospital in rural Gujarat--India. Indian J Med Microbiol. 2010;28(4):342-7.
16. Chopdekar K, Chande C, Chavan S, Veer P, Wabale V, Vishwakarma K, Joshi A. Central venous catheter-related blood stream infection rate in critical care units in a tertiary care, teaching hospital in Mumbai. Indian J Med Microbiol. 2011; 29(2):169-71.
17. Singh S, Chaturvedi R, Garg SM, Datta R, Kumar A. Incidence of healthcare associated infection in the surgical ICU of a tertiary care hospital. Med J Armed Forces India. 2013; 69(2):124-9.
18. Mehta A, Rosenthal VD, Mehta Y, Chakravarthy M, Todi SK, Sen N, Sahu S, Gopinath R, Rodrigues C, Kapoor P, Jawali V, Chakraborty P, Raj JP, Bindhani D, Ravindra N, Hegde A, Pawar M, Venkatachalam N, Chatterjee S, Trehan N, Singhal T, Damani N. Device-associated nosocomial infection rates in intensive care units of seven Indian cities. Findings of the International Nosocomial Infection Control Consortium (INICC). J Hosp Infect. 2007; 67(2):168-74.
19. Burnham JP, Rojek RP, Kollef MH. Catheter removal and outcomes of multidrug-resistant central-line-associated bloodstream infection. Medicine (Baltimore). 2018; 97(42):e12782.
20. Rosenthal VD, Maki DG, Mehta Y, Leblebicioglu H, Memish ZA, Al-Mousa HH, Balkhy H, Hu B, et al., International Nosocomial Infection Control Consortium. International Nosocomial Infection Control Consortium (INICC) report, data summary of 43 countries for 2007-2012. Device-associated module. Am J Infect Control. 2014; 42(9):942-56.
21. Sadeghi-Moghaddam P, Arjmandnia M, Shokrollahi M, Aghaali M. Does training improve compliance with hand hygiene and decrease infections in the neonatal intensive care unit? A prospective study. J Neonatal Perinatal Med. 2015;8(3):221-5.
22. Sherertz RJ, Ely EW, Westbrook DM, Gledhill KS, Streed SA, Kiger B, et al. Education of physicians-in-training can decrease the risk for vascular catheter infection. Ann Intern Med. 2000; 132:641–8.
23. Good, A., Wells, A., Katz, B., Alexander, M., Klokol, D., Chen, M. K., Wong, M. B., Cox, D. C., & Lakey, J. R. MALDI-ToF Analysis of Mitochondrial Peptides. Clinical Medicine Insights, 2022:3(2), 297–303.
24. Khan ID, Basu A, Kiran S, Trivedi S, Pandit P, Chattoraj A. Device-Associated Healthcare-Associated

Infections (DA-HAI) and the caveat of multiresistance in a multidisciplinary intensive care unit. Med J Armed Forces India. 2017;73(3):222-231.
25. Moreno CA, Rosenthal VD, Olarte N, Gomez WV, Sussmann O, Agudelo JG, Rojas C, Osorio L, Linares C, Valderrama A, Mercado PG, Bernate PH, Vergara GR, Pertuz AM, Mojica BE, Navarrete Mdel P, Romero AS, Henriquez D. Device-associated infection rate and mortality in intensive care units of 9 Colombian hospitals: findings of the International Nosocomial Infection Control Consortium. Infect Control Hosp Epidemiol. 2006; 27(4):349-56.