Original Research Article

Study of incidence of central line associated blood stream infections in patients admitted in intensive care unit

Prachi Dubey[1]*, Sanjay Varma[1], Anupam Kujur[1], Bhuwan Sharma[2]

[1]Department of Medicine, Pt. Jawahar Lal Nehru Memorial Medical College, Raipur, Chhattisgarh, India
[2]Department of Neurosciences, Suyash Hospital, Raipur, Chhattisgarh, India

*Correspondence:
Dr. Prachi Dubey,
E-mail: prachidubey012@gmail.com

ABSTRACT

Background: Central venous catheterization is a relatively common procedure in many branches of medicine particularly in anaesthesia and intensive care medicine. Central venous catheters give an easy access for giving drugs as well as for sampling of blood, but they can also be a cause of blood stream infection and sepsis.

Methods: Patients who requiring central venous catheter were selected, relevant blood investigations were done before insertion of catheter and after 48 hours after insertion. With the suspicion of new infection, physical examination and laboratory work-ups were carried out to identify the other source of infection.

Results: Total 96 patients were selected with mean age of 40.0±13.89 years. The incidence of central line-associated bloodstream infection/catheter-related bloodstream infection (CLABSI/CRBSI) in our hospital based study in intensive care units comes out 34.37%. The CLABSI/CRBSI patients (n=33) on general physical examination 5 patients have bradycardia, hypertension hypothermia oliguria altered mental status hypotension tachypnea tachycardia and 26 patients have developed fever during the course of illness. The predominant organism isolated in CLABSI/CRBSI patients is *Staphylococcus aureus*. Central venous catheters are useful in getting access and also source of blood stream investigation. Site of catheter, duration of catheter and co morbidities acts as risk factor for infection.

Conclusions: By knowing the risk factors to cause catheter related infections, risk of getting infection can be lowered by using aseptic technique during insertion and proper catheter care and this can further reduces morbidity and mortality related to central venous catheters.

Keywords: Central venous catheter, Catheter related infections

INTRODUCTION

The use of central venous catheters (CVCs) has increased dramatically over recent years. Central venous catheterization is a relatively common procedure in many branches of medicine particularly in anaesthesia and intensive care medicine. Central venous catheterization was first performed in 1929. Since then, central venous access has become a mainstay of modern clinical practice. Despite the benefits of central venous lines to patients and clinicians, more than 15% of patients will have a catheter related complication. Bloodstream infections caused by central venous catheter remains a serious and the most emerging cause of hospital acquired infections (HAIs) worldwide.[1]

Central line-associated bloodstream infections remain a leading cause of serious healthcare-associated infections in ICUs in India, the rate being 7.9 per 1000 central line-days.[2] Central line-associated bloodstream infection (CLABSI) is mostly a complication of the presence of indwelling medical devices. These central line catheters provide long-term venous access for treatment, delivery of desired medications and blood sampling. Use of central venous catheters (CVCs) lead to blood stream infection which referred as CLABSI. This causes significant

morbidity and mortality to the critically ill patient.[3] Although such catheters provide necessary vascular access, their use puts patients at risk for local and systemic infections, including local site infection, catheter related blood stream infections, septic thrombophlebitis, endocarditis, and other metastatic infections (e.g. lung abscess, brain abscess, osteomyelitis and endophthalmitis).[4] The centre for disease control and prevention (CDC) defines a CLABSI as a blood stream infection caused by an organism not related to another infection when a central line has been in place at some time during the 48 hour prior to the collection of the blood. In contrast, a central line-related blood stream infections (CRBSI) is defined as a blood stream infection with either a positive catheter tip culture or a positive blood culture drawn from the central venous catheter consistent with a culture drawn simultaneously from a peripheral site.[5]

Incidence of bloodstream infections in patients with indwelling catheter is directly related to factors such as site of catheterization, type of procedure, number of attempts, length of catheter inside, duration of catheterization, systemic antibiotics, local site infection of catheter, reason for catheter removal, experience of venipuncturist.[6] Patients with abrupt onset of signs and symptoms of sepsis without any identifiable source should prompt suspicion of infection of an intravascular device.[7] The incidence of BSIs associated with peripheral venous catheters is usually low even though they are used most frequently for vascular access. The majority of serious catheter-related infections are associated with CVCs, especially those that are placed in patients in ICUs.[8] Various authors have reported variable data on CLABSIs from India.[9,10] Notably, Mehta et al reported an overall hospital associated infection (HAI) rate of 4.4% and 9.1% per 1000 intensive care units (ICU)-days and a CLABSI rate of 7.9 per 1000 catheter-days from a prospective surveillance.[2] Recently Kaur et al and Patil et al have done studies in Hospitals in India and concluded that CLABSI rate was 2.8 per 1000 catheter days and 18.5%, respectively.[6,10]

The present study aims to find out the bacteriological profile and their association with various risk factors and other morbidities in patients with CLABSI.

METHODS

This study was an observational, cross-sectional study which included 96 adult patients of various systemic illness admitted in intensive care unit in the department of medicine, Dr. Bhim Rao Ambedkar Memorial Hospital, Raipur, Chhattisgarh in the period from July 2018 to July 2019. Main aim was study was to evaluate bacteriological profile of CLABSIS subjects, and to study the association of various risk factors and morbidities with CLABSIS. Inclusion criteria were patients with age >18 years, and patients should have an indwelling central venous catheter for >48 hours on the date of event. Insertion of first CVC must be during the ICU stay or in the department of medicine or in the medicine ward. Patients, with age <18

years, with indwelling CVC for <48 hours, with blood culture positive at admission were not taken into study. Patients admitted with indwelling central venous catheter in place were also not eligible for study. Daily monitoring for onset of new infection in terms of clinical signs and symptoms was done by using standard criteria after 48 hours of CVC placement. With the suspicion of new infection, physical examination and laboratory work-ups were carried out to identify the other source of infection. New onset of infection was suspected when two or more of the following conditions were present along with suspicion of the infection. 67 fever (temperature >38 ^{0}C) or hypothermia (<36 ^{0}C), tachycardia (>90 beats per minute), tachypnoea (>24 breaths per minute) and, leukocytosis (>12000/mm^3) or leukopenia (<4000/mm^3). Patients with new infection or redevelopment of infection with no apparent source of infection were worked up for CLABSI/CRBSI. This was done by catheter tip culture involving distal 10 cm of catheter tip and two sets of blood culture (one from central line and one from peripheral veins over a span 24 hours) after 48 hours of central line insertion. All data were collected, organized in a tabulated form and statistically analyzed. The analysis was carried out using statistical package for social science (SPSS) version 24.

RESULTS

In this study, 96 patients in intensive care unit who were admitted for various systemic illness and underwent central venous catheterization during the course of their treatment were evaluated, out of which 34 were women (35.5%) and 62 were men (64.5%). Most of the patients belonged to the age group of 41 to 60 years (45.83%). Their age ranged from 18 to 70 years with a mean age of 40.0±13.89 years. The patients who were evaluated in this study have associated with certain co-morbidities. 50 patients have renal failure (52.08%), 10 patients have diabetes mellitus (10.41%), 8 patients have severe anemia (Hb% <7 gm%) (8.33%), 6 patients have underlying cardio-vascular disease (6.25%) and 22 patients were not have any co-morbidity or risk factors (22.91%). The site of central line insertion varies in the study group, 46 patients have Internal jugular vein (47.9%) for central vein access. 40 patients have femoral vein (41.6%) and 10 patients have subclavian vein (10.4%) as central venous access. The study group consists of 57 patients with catheter days more than 10 days (59.37%), of which 20 patients have complicated CLABSI/CRBSI (35.08%) and 5 patients have uncomplicated CLABSI/CRBSI (8.7%) and 32 patients have normal culture report (56.14%). Remaining 39 patients in our study group has catheter days less than 10 days of which 8 patients have developed complicated CLABSI/CRBSI (20.51%) and 31 patients have normal culture report (79.48%). The incidence of CLABSI/CRBSI in our hospital based study in intensive care units comes out 34.37% (33/96 patients, p value- 0.0002). Of which 29.16% incidence is of complicated CLABSI/CRBSI (28/96 patients, p value-0.0008) and 5.20% incidence is of uncomplicated CLABSI/CRBSI

(5/33 patients, p value-0.0032) (Table 1). Separately, the incidence of CLABSI is 21/96 patients (21.8%) and the incidence of CRBSI is 4/96 patients (4.16%) and 8/96 patients (8.33%) represented as positive catheter tip colonization (Table 2).

Table 1: Distribution of CLABSI/CRBSI patients in different categories.

Parameter	Number of patients	Percentage
Complicated CLABSI/CRBSI	28	29.1
Uncomplicated CLABSI/CRBSI	5	5.2
Normal culture report	63	65.6
Total	96	100

Table 2: Blood culture and CVC tip culture results.

Blood culture	Tip culture	Impression	Number of cases (%)
Positive	Negative	CLABSI	21 (21.8)
Positive	Positive	CRBSI	4 (4.16)
Negative	Positive	Catheter tip colonization	8 (8.33)
Negative	Negative	No CLABSI/CRBSI	63 (65.6)
Total			96 (100)

Table 3: Distribution of signs on general physical examination (n=33).

Signs	Number of CLABSI/CRBSI patients	Percentage (%)
Bradycardia	5	15.1
Hypertension	4	12.1
Hypothermia	4	12.1
Oliguria	14	42.4
Altered mental status	16	48.4
Hypotension	22	66.6
Tachypnea	27	81.8
Tachycardia	20	60.6
Fever	26	78.7

The CLABSI/CRBSI patients (n=33) on general physical examination 5 patients have bradycardia (15.1%), 4 patients have hypertension (12.1%), 4 patients have hypothermia (12.1%), 14 patients have developed oliguria (42.4%), 16 patients have altered mental status (48.4%), 22 patients have developed hypotension (66.6%), 27 patients have developed tachypnea (81.8%), 20 patients have developed tachycardia (60.6%), 26 patients have developed fever during the course of illness (78.7%) (Table 3). The predominant organism isolated in CLABSI/CRBSI patients (n=33) is *Staphylococcus aureus* (36.3%) in 12 patients, 5 patients have *Pseudomonas*

aeruginosa, (15.1%) 3 patients have *Candida* species, (9%) 3 patients have *Escherichia coli*, (9%) 4 patients have *Streptococcus*, (12.1%) 5 patients have *Klebsiella pneumonia*, (15.1%) and 1 patient has *Acinetobacter* (3.1%) in culture growth (Table 4).

Table 4: Percentage of pathogen isolated from culture.

Isolated pathogen	Number of CLABSI/CRBSI patients	Percentage
Staphylococcus aureus	12	36.3
Pseudomonas aeruginosa	5	15.1
Candida species	3	9.0
Escherichia coli	3	9.0
Streptococcus	4	12.1
Klebsiella pneumoniae	5	15.1
Acinetobacter	1	3.1
Total	33	100

DISCUSSION

The present study was aimed at to assess the incidence of CLABSI/CRBSI in patients admitted in intensive care units for various systemic illnesses and underwent central venous catheterization during the course of their treatment. In our study, 96 patients were evaluated who were admitted in intensive care units and central venous catheterization was done. The blood culture and catheter tip culture were done later on for assessment of CLABSI/CRBSI. The incidence of CLABSI/CRBSI in our hospital based study in intensive care units comes out 34.37%. Other studies have shown variable incidence, Patil et al study showed incidence of 47.13 while other studies have shown lower incidences.[11-13] This variability of incidences in various studies could be due to various factors like techniques, site of catheterization, type of catheter used, catheter care and diagnostic criteria used for diagnosing CLABSI/CRBSI. The high infective complication rate in the present study may have been due to the fact that our hospital is catering to the lower socioeconomic group. Therefore, the overall hygiene of the patients is poor. Secondly, it was usually done as an emergency procedure.

The patients who were evaluated in our study have associated with certain co-morbidities. 50 patients have renal failure (52.08%), 10 patients have diabetes mellitus (10.41%), 8 patients have severe anemia (Hb% <7 gm%) (8.33%), 6 patients have underlying cardio-vascular disease (6.25%) and 22 patients were not have any co-morbidity or risk factors. (22.91%). Patients with some chronic illness have greater chance of developing CLABSI/CRBSI, which was studied by Horan et al. [5]

The site of central line insertion varies in the study group, 46 (47.9%) patients have internal jugular vein for central vein access, 10 (10.4%) patients have subclavian vein and

40 (41.6%) patients have femoral vein as central venous access. In these preferred routes, femoral route has greater incidence of CLABSI/CRBSI, according to the study conducted by Mehta et al.[2] In our study out of 33 CLABSI/CRBSI positive patients, 12 patients (36.36%) have internal jugular vein, 18 patients (54.54%) have femoral vein and 3 patients (9.09%) have subclavian vein as central vein access. The study group consists of 57 patients with catheter days more than 10 days (59.37%), of which 20 patients have complicated CLABSI/CRBSI (35.08%) and 5 patients have uncomplicated CLABSI/CRBSI. (8.7%) and 32 patients have normal culture report. (56.14%) Remaining 39 patients in our study group has catheter days less than 10 days of which 8 patients have developed complicated CLABSI/CRBSI (20.51%) and 31 patients have normal culture report (79.48%). In our study incidence of CLABSI/CRBSI is more in catheter days more than 10 days, which shows greater is duration of catheterization more is risk of developing catheter related infection. Similar finding is also mentioned in the study conducted by Patil et al.[6]

Our findings justify frequent clinical assessment of patients with indwelling catheter, and based on the signs and symptoms we can suspect central line related infections timely. And patients with risk factors like chronic illness, immune-compromised status, prolonged catheter days should be frequently monitored and blood culture and antibiotic sensitivity testing should be carried out timely to improve outcomes. Our findings also suggest that more research is needed as the literature is scarce.

CONCLUSION

Catheter related blood stream infection is a very serious complication of central venous catheter. It is more common in patient who have co-morbidities like Obesity, Renal failure, diabetes mellitus, cardio-vascular disease and anemia. In our study we found that femoral CVCs related infection is highly prevalent in patients and *Staphylococcus aureus* is the highly prevalent organism and shows their antibiotic sensitivity. So by using aseptic technique during insertion and proper catheter care we can reduce the chances of infection and further morbidity and mortality related to CVCs.

REFERENCES

1. Edwards JR, Peterson KD, Andrus ML, Tolson JS, Goulding JS, Dudeck MA. National Healthcare Safety Network (NHSN) Report, data summary for 2006. Am J Infect Control. 2007;35:290-301.
2. Mehta A, Rosenthal VD, Mehta Y. 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.
3. Frasca D, Dahyot-Fizelier C, Mimoz O. Prevention of central venous catheter-related infection in the intensive care unit. Crit Care. 2010;14:212.
4. Khanna V, Mukhopadhayay C, Vandana KE, Verma M, Dabke P. Evaluation of Central Venous Catheter Associated Blood Stream Infections: A Microbiological Observational Study. J Pathol. 2013;2013:1-6.
5. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of healthcare-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control. 2008;36:309-32.
6. Patil HV, Patil VC, Ramteerthkar MN, Kulkarni RD. Central venous catheter-related bloodstream infections in the intensive care unit. Indian J Crit Care Med. 2011;15(4):213-23.
7. Brachman PS. The intensive care unit. In: Bennett JV, Brachmann PS, editors. Hospital Infections. 5thedition. Philadelphia: Lippincott Williams and Wilkins. 2007;395-416.
8. Naomi P, Alexander M, Dellinger EP. Centers for Disease Control and Prevention. Guidelines for the Prevention of Intravascular Catheter-Related Infections. 2002;51:1-26.
9. Mehta A, Rosenthal VD, Mehta Y, Chakravarthy M, Todi SK, Sen N, et al. Device-associated nosocomial infection rates inintensive care units of seven Indian cities. Findings of the International Nosocomial Infection Control Consortium (INICC). J Hosp Infect. 2007;67:168-74.
10. Kaur R, Mathai AS, Abraham J. Mechanical and infectious complications of central venous catheterisations in atertiary-level intensive care unit in northern India. Indian J Anaesthesia. 2012;56:376-81.
11. Lucet JC, Bouadma L, Zahar JR, Schwebel C, Geffroy A, Pease S, et al. Infectious risk associated with arterial catheters compared with central venous catheters. Crit Care Med. 2010;38:1030-5.
12. Fortún J, Perez-Molina JA, Asensio A, Calderón C, Casado JL, Mir N, et al. Semiquantitative culture of subcutaneous segment for conservative diagnosis of intravascular catheter related infection. JPEN J Parenter Enteral Nutr. 2000;24:210-4.
13. Deshpande KS, Hatem C, Ulrich HL, Currie BP, Aldrich TK, Bryan-Brown CW, et al. The incidence of infectious complications of central venous catheters at the subclavian, internal jugular and femoral sites in an intensive care unit population. Crit Care Med. 2005;33:13-20.