Central Line-Associated Bloodstream Infection: A Case Study

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Abstract

Introduction: Use of vascular catheters is common in both inpatient and outpatient care. In the United States, it is estimated that almost 300 million catheters are used each year; nearly 3 million of these are central venous catheters (CVCs), also known as central lines.

Material and Method: Prospective observational study includes 50 patients aged more than 18 years admitted to SICU / surgical wards / transferred from either, in whom central line access inserted. During the study period the total number of patients admitted to the hospital was monitored daily and the patients meeting the inclusion criteria were enrolled in the study. The surveillance of CLABSI (central line associated blood stream infection) was performed in surgical intensive care unit, and all surgical wards, including burns wards. The data were collected using a standardized proforma.

Observation: The incidence rate of central line catheter colonization of various studies ranges from 31.58% to 76 % . In all other studies, gram positive cocci were the predominant colonizers of central venous catheter, but in our study, we found gram negative bacilli like Klebsiella, E-coli, Pseudomonas aeruginosa, Acinetobacter species, species to be the predominant ones compare to gram positive cocci like Staphylococcus species.

Conclusion: In present study incidence of CLABSI is 3.27% which almost equal to its global incidence. Commonest organism in present study is klebsiella followed by pseudomonas.

Key words: CLABSI, CDC, CVP, Subclavian route

INTRODUCTION

Use of vascular catheters is common in both inpatient care and outpatient care. In the United States, it is estimated that almost 300 million catheters are used each year; nearly 3 million of these are central venous catheters (CVCs), also known as central lines. In the United Kingdom, about 250,000 CVCs are used annually.[1] CVCs play an integral role in modern health care, allowing for the administration of intravenous fluids, blood products, medications, and parenteral nutrition, as well as providing hemodialysis access and hemodynamic monitoring; their use, however, is associated with a risk of bloodstream infection caused by microorganisms colonizing the external surface of the device or the fluid pathway when the device is inserted or in the course of its use.[2] CVCs are the most frequent cause of health-care-associated bloodstream infections. The terms used to describe intravascular catheter-related infections can be confusing.

CLABSI is the term used by the US Centres for Disease Control and Prevention's (CDC's) National Healthcare Safety Network (NHSN)[3]. CLABSI is a primary bloodstream infection (that is, there is no apparent infection at another site) that develops in a patient with a central line in place within the 48-hour period before onset of the bloodstream infection that is not related to infection at another site. Culturing the catheter tip or peripheral blood is a criterion for CLABSI.[4]

The Magnitude of the Problem Infections that patients develop while they are receiving care in a health

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care setting for another condition are termed health care–associated infections (HAIs) HAIs occur throughout the world, affecting hundreds of millions of patients each year.[5] These infections are not only costly to individuals and health care systems; they can significantly increase morbidity and mortality in developed countries and in developing countries. Seriously ill patients are particularly vulnerable to serious complications due to HAIs, likely due to factors such as progressively more invasive medical technology and complex medical procedures, increasing immunocompromised status and elderly age, and the rising incidence of antimicrobial resistance.[6] It has been estimated that 80,000 CLABSIs occur in ICUs in the each year in india; however, if patients outside ICUs are also included, the estimate increases to 250,000 cases of CLABSI each year. CLABSIs are serious but often preventable infections when evidence-based guidelines are followed for the insertion and maintenance of central lines.

The present study is the prospective observational study of monitoring for 12 months the occurrence of CLABSI in surgery department of a tertiary care center, government medical college, Surat.

AIMS OF THE STUDY

The aims of this study were as follows:
1. To document the incidence of central line-associated infective complications in adult patients in surgical ICU (SICU)/surgical wards in our institute.
2. To document possible causes of central line-associated infective complications in our institute.
3. To observe and document preventive steps for central line-associated infective complication.
4. To study the pattern of most common organism isolated and most common sensitive drugs to them in current time in our institute.
5. To document the adverse effects of CLABSI in terms of increased hospital stay, morbidity, and mortality, to notify the same, and to know the outcome of the patients.

MATERIALS AND METHODS

Study Setting
The prospective observational study includes 50 patients aged >18 years admitted to SICU/surgical wards/transferred from either, in whom central line access inserted between May 2017 and October 2017 in New Civil Hospital (NCH), Surat.

Inclusion Criteria
All patients of >18 and <60 years with central line inserted in SICU/surgical wards following standard protocol of insertion checklist and maintenance checklist were included.

Exclusion Criteria
The following criteria were excluded from the study:
- Central line inserted outside this tertiary care center
- Patients of <18 years of age
- Patients of >60 years of age
- Patients with arteriovenous fistula
- Neutropenic patients.

Data Collection
During the study period, the total number of patients admitted to the hospital was monitored daily and the patients meeting the inclusion criteria were enrolled in the study. The data were collected daily. Ethical approval was taken because the survey procedure was going to include some blood sample to be withdrawn from patients and sent for microbiological examination according to the criteria. The surveillance of CLABSI was performed in surgical ICU and all surgical wards, including burns wards. The data were collected using a standardized pro forma. The data were collected and entered in the study database, following the guidelines of CDC Atlanta 2017. For each patient, the following data were entered into the study database: Demographic data, reason for admission, underlying illness, type of device, and antibiotic treatment. Reasons to stop the follow-up were hospital discharge, device removal, or infection event related to the device.

Clinical, hematological, and microbiological criteria for diagnosis were recorded in case of infection. The pathogen identified was also documented.

Case Definitions
CLABSI was defined according to the CDC and Prevention criteria. CLABSI is defined as laboratory-confirmed bloodstream infection where central line or umbilical catheter and peripherally inserted central catheters were in place for >2 calendar days on the date of event, and the line was in place on the date of event or the day before. To capture data only about infections acquired during the hospitalization, the definition of CLABSI was considered valid only if the positive blood culture and clinical signs/symptoms of infection occurred after at least 48 h from admission.

The present study was a prospective observational study which observed and analyzed 50 patients, in whom central line was inserted at NCH, Surat. Central line and case selection definition are taken as per CDC module. 50 patients observed for the signs of infective complication which either a local or systemic.

Local infective complications are as follows:
- Redness at/around insertion site
- Tenderness at/around insertion site
- Discharge from insertion site

Systemic sign of CLABSI: Fever (>100), chills, and hypotension.

Scenario 1

In present study pre-insertion, during central line *in situ*, after removal CBC (complete blood count) of all patients was documented. Patients showing signs of infection either local and/or systemic in such patients two blood culture one from central line and one from peripheral site were taken after 48 hours of period which is considered to be a incubation period of organism which if comes positive will be suspected to be HAIs in form of CLABSI (catheter related blood stream infection) with exclusion of secondary blood stream infection by culturing either urine/wound swab/endotracheal secretion. these samples were also sent for culture and sensitivity to rule out primary source from central line catheter. To claim CLABSI central line tip (5 cm distal tip) was also sent for culture and sensitivity. cultures showing organism and it's antibiogram were documented as per CDC module.

Scenario 2

If a patient shows no signs of infection and such cases, only central line tip was sent for culture and sensitivity. If it shows any organism, the same will be documented as subclinical infection.

Central line insertion check list		
Practice	**Yes**	**No**
Right technique to wash hands		
Sterile gloves		
Gown		
Mask, cap		
Clean area with 2% chlorhexidine		
Sterile drapes		
Sterile transparent dressing to entry site		
Three-way taps and infusions connected aseptic technique?		
Wash hands after the procedure		
X-ray after the procedure and seen by doctor?		
Documents of procedure in the notes		

Central line maintenance check list						
Local site	Day 0			Day 7		
	Am	Pm	Night	Am	Pm	Night
Transparent dressing						
Tenderness at site						
Redness at site						
Dressing soaked						
Dressing changed						
Tubing changed						

OBSERVATION AND DISCUSSION

The present study includes 50 cases, in whom central venous access was obtained for various purposes. They were studied for CLABSI and related mortality and morbidity in terms of average duration of hospital stay.

In the present study of 50 cases, there were 9 cases between 18 and 30 years making 18%, 17 cases between 31 and 40 years of age making 34%, 10 cases between 41 and 50 years making 20%, and 14 cases between 51 and 60 years making 28% of study population. In the present study, there was male preponderance with 35 male forming 70% of study population, while 15 female patients consist of 30% of study population. Overall admission ratio of female: male was very low, so male preponderance for CLABSI was also expected in results; hence, there was no significant association drawn from the study regarding gender preponderance of CLABSI.

In the present study, 50 central line insertions were observed and taken for the study in a surgical ICU and wards at NCH, Surat. There was a triple lumen central line preponderance with 29 triple lumen central lines with 58%, while double lumen was 18 consisting of 36%, and only three central lines were single lumen of 50 central line. In another study, Venturini *et al*. with 100 patients with 22 central lines being triple lumen and 58 central lines being double lumen and 20 central lines were single lumen. Overall, there is a preponderance for triple lumen in the present study while another study has more double lumen central lines as later study shows risk association between a number of CLABSI incidence and number of central line lumens.

In the present study of 50 central lines, 46 were inserted through the right infraclavicular subclavian vein, while four central lines were inserted through the jugular vein. In view of the risk of fatal complication such as pneumothorax, arterial puncture world literature prefers to insert jugular. While subclavian has least chance of infection and so most of the central line in surgery department being inserted are subclavian. Hence, it also reflected in the present study due to limited study population in whom the jugular vein was cannulated, so significant association could not be drawn regarding the association between the incidence of CLABSI and route of insertion. Otherwise, both of CLABSI incidences in the present study had subclavian vein central line inserted.

Dressing material	Number of cases	Infections
Transparent dressing	44	CLABSI-1 Subclinical-6
Dynaplast	5	CLABSI-1 Subclinical-2
G-plast	1	CLABSI-0 Subclinical-1
Gauze dressing	0	CLABSI-0 Subclinical-0

CLABSI: Central line associated bloodstream infection

In the present study, protocol was fixed to use transparent dressing, and in most of the patient being 44 where

transparent dressing was used only while 5 patient had dynaplast was used.1 patient G plast was used as a dressing material

In the present study, patients were observed for on which day dressing is changed, either by soakage, loosening, or in absence of any of them every 7th day if transparent dressing is used. In our observation, 17 patients had their dressing which changed on 7th day, and of them, two patients had central line tip positive after removal while two patients had CLABSI. Ten patients had dressing changed on 6th day and both patient's central line tips was positive for organism with different antibiograms. 6 patients had dressing which changed on 5th day and 5 of 6 patient's central line tips were positive with antibiogram being different. 4th day 7 patients had dressing changed 2 patients tip turns positive. 3rd day 8 patients had dressing changed 1 patient's tip was positive. 2nd day 2 patients had dressing changed 1 patients tip turns positive

Indication for insertion of central line			
Indication	No infection	Subclinical Infection	CLABSI
PN	2	2	0
TPN	11	2	2
Vasopressor	25	4	0
For Venous access	1	1	0

TPN: Total parenteral nutrition, PN: Parenteral nutrition, CLABSI: Central line associated bloodstream infection

In the present study, various indications for insertion of the central line were documented. The most common indication of insertion was need of vasopressor agents in 29 patients; of them, 25 had no clinical or microbiological infection, and four patients had microbilogical infection in the form of positive tip culture after removal at the time of discharge or death. Two patients were inserted central line for in availability of peripheral venous access; of them, 1 had microbiological infection. 2 patients had microbiological infection of 4 patients in whom central line was inserted for parentral nutrition and 2 patients had negative tip culture after removal.

Incidance of CLABSI	
Present study	3.27
Naveen *et al*.	18.6
Venturini *et al*.	3.73

CLABSI: Central line-associated bloodstream infection

Total central venous pressure days		
Days	Total days	Average days per case
Indoor days	877	17.54
Pre-insertion days	186	3.72
CVP days	610	12.2
Post-insertion	91	1.82

CVP: Central venous pressure

$$\text{CLABSI rate per 1000 catheter days} = \frac{\text{No. of CLABSI cases} \times 1000}{\text{No. central line catheter days}}$$

In the present study, two patients had CLABSI of 50 patients in whom central line inserted. Total cumulative days of the central line *in situ* were 610 days with 50 patients having cumulative 877 indoor days. With these statistics, the average duration of one patient having central line *in situ* was 12.2 days compared to 7.6 days in Naveen *et al*. and 10.2 days in Venturini *et al*. in present study incidence of CLABSI is 3.27% per 1000 catheter days. This is higher than that of the National Nosocomial Infections Surveillance System Report (1.8–5.2 per 1,000 catheter days). Our study matched the infection rate incidence of Yilmaz *et al.,* 3.1, and Almuneef *et al.,* 4.1, per 1000 catheter days. Our study had very low incidence of CLABSI than Naveen *et al*. which had 18.6 per 1000 catheter days. But very near to global incidence of 3.73.

In the present study, of 50 patients, 7 patients show signs of local complication, in which 3 patients had tenderness at insertion site of central line. One patients had redness at insertion site. One patient had pus discharge from insertion site which shows *Escherichia Coli* organism and later found to be CLABSI with positive peripheral and central blood culture.

In the present study, out 34 patients discharged and 16 patients expired. No mortality was associated with the incidence of CLABSI. Tip was positive for organism in three patients in whom the tip was sent for culture after removal due to death, but none of the patients had a positive sign of infection during central line *in situ*. Hence, this mortality was not attributed to CLABSI.

Organism and sensitivity		
Organism	Number of cases	Sensitivity
Klebsiella	3	Polymixin-B-2, Colistin -1
Pseudomonas	2	Ceftazidime-2,
E. coli	2	Polymyxin B-1, Colistin-1
MRSA	1	Meropenem-1
Acinetobacter	1	Meropenem-1

MRSA: Methicillin-resistant Staphylococcus aureus, E. coli: Escherichia coli

In the present study, organism found on culture of wound/blood culture/tip culture was studied for their antibiogram. *E. coli* and *Klebsiella* were isolated with different antibiograms in the form of two *Klebsiella* being most sensitive to poly-B only and one with colistin. Of 2 *E. coli* isolates, 1 for poly-b and 1 for colistin were the most sensitive. Meropenem was the most sensitive drug for Methicillin-resistant *Staphylococcus aureus* and

Acinetobacter isolates. One *Pseudomonas* isolate is being sensitive for ceftazidime. The incidence rate of central line catheter colonization of various studies ranges from 31.58% to 76%. In all other studies, Gram-positive cocci were the predominant colonizers of CVC, but in our study, we found Gram-negative bacilli such as *Klebsiella, E. coli, Pseudomonas aeruginosa, Acinetobacter* species, species to be the predominant ones compare to gram positive cocci like *Staphylococcus* species. Organisms such as *P. aeruginosa* and *Acinetobacter* species which are saprophytes favoring moist environment could be the causative agents when there is moisture around the exit sites.

CONCLUSION

CLABSI remains an important complication of central venous access in surgical ICUs and wards. The duration of catheterization and colonization has an important role in the development of CLABSI along with various other causes which may lead to septicemia and multiorgan failure.

In the present study, the following things were concluded:
1. Need for vasopressor was the most common indication for insertion of central line, followed by total parenteral nutrition and as a venous access.
2. Multiple lumens are preferred over single lumen.
3. The most common site of central line insertion is subclavian followed by jugular followed by femoral.
4. In the present study, the incidence of CLABSI is 3.27 which is almost equal to its global incidence.
5. The most common organism in the present study is *Klebsiella* followed by *Pseudomonas*.
6. The most common drug sensitive to *Klebsiella* in the present study is polymyxin for *Klebsiella* and ceftazidime for *Pseudomonas*.
7. Average duration of hospital stay is 17.54 days and average duration of central line *in situ* is 12.2 days.

CLABSI should be suspected in all the catheterized patients having signs and symptoms of septicemia.

Local antibiotics, strict preventive bundles, and catheter lock solutions should be used as preventive measure while inserting the central line catheter. The long duration of catheterization increases the morbidity and mortality, so regular monitoring of catheterized patients should be done for both insertion site and general condition.

Culture and sensitivity pattern can be a very good guide to treat specific organism as most isolates are resistant to commonly used antibiotics.

This may also be accompanied by the removal of the catheter to reduce the mortality and morbidity from CLABSI, thus producing better patient care and outcome.

If proper sterile precaution is performed while insertion of central line and its maintenance incidence of CLABSI will not definitely more than global incidence rate. In our study, rate is almost near to global incidence of CLABSI.

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