



TO STUDY THE INCIDENCE OF BLOODSTREAM INFECTIONS RELATED TO CENTRAL VENOUS CATHETERISATION IN INTENSIVE CARE UNIT OF A TERTIARY LEVEL HOSPITAL

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ABSTRACT

Introduction: This study was designed to evaluate incidence of bloodstream infections related to central venous catheterisation in intensive care unit of a tertiary level hospital.

Material and methods: Study place- Intensive care unit of a tertiary level hospital

Study population-150 patients were included in study after meeting inclusion and exclusion criteria. All the patients who received a CVC (Jugular/subclavian/femoral) in the operation theatre either as a part of anaesthetic care or in the ICU, were included in the study.

Study design- It was Prospective observational study.

Result: This study revealed a total of 24.66% of CVC associated infections. This included exit site infections (5.33%), catheter tip infections (13.33%) and CRBSI (6%). The rate of infections associated with Central Venous Catheterization was 35.03 per 1000 catheter days.

KEYWORDS :

INTRODUCTION

Central venous catheters (CVCs) are an integral part of patient care in the intensive care unit (ICU). CVCs are often used as a portal for the delivery of medications, parenteral nutrition, collection of blood samples and monitoring hemodynamic variables in critically ill patients. However, complications associated with CVCs occur in nearly 15% of patients, mainly infectious complications (5-26%), mechanical complications (5-19%) and thrombotic complications (2-26%)[1]. These result in prolongation of ICU and hospital stay, increased hospital costs, morbidity and mortality[2]. Despite the advent of ultrasound-guided vascular cannulation, which has reduced the incidence of insertion complications drastically, many hospitals in India and other developing countries still rely on the landmark based technique for cannulation, which has a reported success rate of 75-99%[3].

Use of CVC puts patients at risk for local and systemic infectious complications, including local site infection, Catheter Related Blood Stream Infections (CRBSI), septic thrombophlebitis, endocarditis, and other metastatic infections (e.g., lung abscess, brain abscess, osteomyelitis, and endophthalmitis).

CRBSI constitute one of the major nosocomial device associated infections[4]. For the surveillance of device associated infections, the data needs to be expressed as the number of device associated infections per 1000 device days as per the recommendations from the Center for Disease Control and Prevention, USA[5].

However, there has been very little data reported from adult Indian ICUs on the rates of complications associated with CVC insertion and use, especially of infectious complications. The magnitude of the potential for CVCs to cause morbidity and mortality resulting from infectious complications has been estimated in several studies. According to the National Nosocomial Infection Surveillance System of the CDC the rate of catheter-related bloodstream infection in ICUs range from 1.8 to 5.2 per 1000 catheter-days[6]. The cost of CVC-associated BSI is substantial, both in terms of morbidity and in terms of financial resources expended.

To improve patient outcome and reduce health-care costs,

strategies should be implemented to reduce the incidence of these infections. This effort should be multidisciplinary, involving health-care professionals who insert and maintain intravascular catheters, health-care managers who allocate resources, and patients who are capable of assisting in the care of their catheters, regular surveillance needs to be undertaken for the formulation of appropriate infection control practices. Absence of in-house data leads to difficulties in planning of local strategies to tackle the menace of catheter related complications esp CRBSI.

MATERIALS & METHODS

Study place

The study was conducted in department of anaesthesiology of armed forces medical college, Pune after approval from ethical committee and written consent taken from all patients before being included in the study.

Study population

Patients requiring CVCs admitted in adult surgical intensive care unit.

150 patients were included in study after meeting inclusion and exclusion criteria.

Study design

It was Prospective observational study.

Inclusion criteria

All the patients who received a CVC (Jugular/subclavian/femoral) in the operation theatre either as a part of anaesthetic care or in the ICU, were included in the study.

Exclusion criteria

- Patients with obvious source of infection excluded (fever, pneumonia, urinary tract infection, cellulitis, septicemia) by history, clinical examination, blood culture, chest X-ray, urine examination, etc. and relevant investigations pertaining to the suspected infection.
- Patients having infective endocarditis, retroviral disease and immunosuppressive drugs.
- CVC insertions performed on patients without verifying their coagulation profile (as in an emergency) or on patients with uncorrected coagulopathy were excluded from the study.

METHODOLOGY

- The study was conducted from May 2017 to Jun 2018. Approval and written permissions from the hospital ethics and research committee was obtained. All the patients who received a central venous catheter (Jugular/subclavian/femoral) in the operation theatre either as a part of anaesthetic care or in the ICU were included in the study. Appropriate consent also was taken either from the patients themselves or from the next of kin or a legal surrogate.
- CVC insertions performed on patients without verifying their coagulation profile (as in an emergency) or on patients with uncorrected coagulopathy were excluded from the study.
- Baseline data on each patient, like primary diagnosis, presence of any comorbid illnesses, date of ICU admission and APACHE II score was recorded. For each CVC insertion, data was collected as per the proforma attached (Annexure I). Central venous cannulations were performed only when the platelet count was more than 50,000/cumm and the prothrombin time (International Normalized Ratio) was less than 1.5 s, as per the ICU protocol.

Central venous catheterization-

- Hand disinfection using an antiseptic rub was preferred during catheter insertion. For the insertion of CVCs, full scrub (up to the elbows) with an antiseptic solution was used. The maximal sterile barrier precautions in the form of use of cap, mask, sterile gloves, full-sleeved sterile gown and large sterile drapes were used. To prepare clean skin, alcoholic chlorhexidine (2%) was used. All lines were placed percutaneously using the Seldinger technique. The CVC was placed according to the indication of its insertion and was held in situ by using suture. Sterile transparent dressing was used at the catheter site.
- All the cannulations were performed either by an ICU consultant or anesthesiologist or by a 2nd or 3rd year resident (with a minimum prior experience of at least 20 CVC insertions, under the supervision of a consultant). The choice of the CVC insertion site (either IJV/SCV/Femoral) was left to the discretion of the performing doctor.
- Hand hygiene procedures were strictly followed before and after injection, blood sampling, dressing or any contact with the CVC or insertion site. The dressings were changed every day, the site was inspected for purulence and erythema and palpated for tenderness and induration (local signs of CVC infection).
- The date, site and side of cannulation and the number of punctures required for successful cannulation as well as complications, if any, were noted for each insertion procedure.
- The details of type of placement (emergency/elective), technique of placement (landmark/ ultrasound guided), duration of placement (<72 h/>72 h), type of catheter (7 fr 01 lumen/7 fr 02 lumen/7 fr 03 lumen), infection at catheter-insertion site, signs of systemic infections were also noted.
- CVCs were removed when no longer required or when suspected to be infected. The total duration of CVC placement was also be recorded. The catheter tip was sent for microbiological analysis after removal.
- On suspicion of an insertion-site infection (indicated by erythema/pus at the entry point), site swabs were sent for microbiological analysis. If catheter tip colonization/ infection or catheter-related blood stream infection (CRBSI) was suspected, the CVC was removed and the distal 5 cm of the CVC was collected aseptically in a sterile test tube and transported immediately to the laboratory for culture. Immediately subsequent to catheter removal, two sets of blood (10ml) were collected aseptically from two different peripheral sites (right and left) for blood culture and sent for culture analysis. All CVC tips were cultured

using the standard Semi Quantitative Culture (SQC) method.. The type of micro-organism growth was also be recorded.

- Catheter tip colonization was defined as growth of more than 15 colony forming units on culture of the distal segment of the CVC.

Negative semiquantitative culture technique

A negative SQC result was defined as an SQC yielding less than 15 colony forming units (cfu) in the absence of positive blood culture.

- **Catheter-associated infections** were defined as follows:
 - **Exit site infection-** erythema, tenderness, induration or purulence within 2 cm of skin at the insertion site of catheter along with microbiological growth on culture of the purulent exudates.
 - **Catheter tip infection-** growth of more than 15 colony forming units on culture of the distal segment of the CVC with clinical signs of infection but without associated bacteraemia. ((i.e. catheter tip colonization without associated bacteraemia)

Catheter related local infection (CRLI)- It includes exit site infection and catheter tip infection.

- **Catheter-Related Bloodstream Infections (CRBSI/CRBI)-** isolation of the same organism from the catheter tip culture (growth of more than 15 colony forming units) and from at least one of the two blood cultures, along with signs and symptoms of infection. (i.e. catheter tip colonization with associated bacteraemia)
- Thus, patients with clinical signs of infection and in whom the CVC tip yielded a positive growth (but without associated bacteraemia) were considered as having catheter tip infections while patients with clinical evidence of infection along with positive growth of the same organism on blood culture as well as CVC tip were diagnosed to have CRBSI.
- The rate of catheter associated infections was calculated as **incidence** i.e. percentage of patients who developed catheter associated infections out of total number of patients and **incidence density** (per thousand catheter days) i.e. number of patients who developed catheter associated infections per thousand catheter days.

$$\text{Incidence(\%)} = \frac{\text{No. of patients developed catheter associated infections}}{\text{Total no. of patients}} \times 100$$

$$\text{Incidence density} = \frac{\text{No. of patients developed catheter associated infections}}{\text{Total no. of catheter days}} \times 1000$$

- Besides the data related to CVCs, the outcomes of all patients included in the study at the end of ICU stay i.e. died or discharged, were also be recorded.

STATISTICAL ANALYSIS

After data collection, data entry was done in Microsoft Excel sheet. Data analysis was done with the help of SPSS software version 20.0.

Quantitative data was presented with the help of mean and standard deviation. Qualitative data was presented with the help of frequency, percentage. Analysis or their significance was done by using the p values obtained through chi square test. For statistical comparison, the difference was considered significant when the p-value was found to be less than 0.05.

RESULTS

A total of 150 patients in the age group between 14 and 86 years of both genders with indwelling CVCs were included. Of

150 patients, 95 (63.33%) were males and 45 (36.66%) were females(Table-1). The minimum age was 14 years and the maximum age was 86 years, with an overall mean age of 53.82 (± 16.42) years(Table-1).

Internal jugular route was used in 130 (86.66%) patients, subclavian route in 18 (12%) and femoral route in 2 (1.33%) patients(Table-2).

Of the 130 patients who were having internal jugular venous catheters, 25 (19.23%) patients had catheter tip colonization and 8 (6.15%) patients had exit site infection. Of the 25 patients who were having catheter tip colonization , 7 patients were of CRBSI and 18 patients were of catheter tip infection. Of the 18 patients who were having subclavian venous catheters, 4 (22.22%) patients had catheter tip colonization and out of these 4 patients, 2 patients were of CRBSI and 2 patients were of catheter tip infection.

Of the 09 patients in which catheter duration was ≤ 3 days, 01 (11.11%) patient had catheter tip infection and 01 (11.11%) patient had exit site infection. Of the 141 patients in which catheter placed for more than 3 days, 28 (19.85%) patients had catheter tip colonization and 7 (4.96%) patients had exit site infection. Of the 28 patients who were having catheter tip colonization, 9 patients were of CRBSI and 19 patients were of catheter tip infection. Of the 12 patients in which catheter

inserted as an emergency procedure, there was no colonization of catheter and 2 (16.66%) patients had exit site infection. Of the 138 patients in which catheter inserted as an elective procedure, 29 (21.01%) patients had catheter tip colonization and 6 (4.35%) patients had exit site infection. Of the 29 patients who were having catheter tip colonization, 9 patients were of CRBSI and 20 patients were of catheter tip infection.

Of the 87 (58%) patients in which central venous catheterizations done in a single attempt, 11 (12.64%) patients had catheter tip colonization and 4 (4.59%) patients had exit site infection. Of the 11 patients who were having catheter tip colonization, 3 patients were of CRBSI and 8 patients were of catheter tip infection. Of the 53 (35.33%) patients in which central venous catheterizations done in two attempts, 15 patients had catheter tip colonization and 4 (7.55%) patients had exit site infection. Of the 15 patients who were having catheter tip colonization , 4 patients were of CRBSI and 11 patients were of catheter tip infection. Of the 10 (6.7%) patients in which central venous catheterizations done in three attempts, 03 showed catheter tip colonization and out of these 03 patients, 2 were of CRBSI and 1 patient was of catheter tip infection.

Of 150 patients who were included in the study, 8 patients died and 142 patients discharged.

Table 1: Univariate analysis comparing the demographic profile and insertion characteristics among different cannulation site

Variables studied	Total	IJV	SCV	Femoral Vein	F score/chi square	p value	Significance
Total CVCs	150	130	18	2	84.76	0.00	Significant
Mean age (S.D.)	53.82(16.42)	54.07(16.32)	52 (17.47)	47.5(31.82)	0.27	0.767	Not Significant
Gender (male/female)	(95/55)	(81/49)	(13/5)	(1/1)	0.67	0.413	Not Significant
APACHE II score; mean (S.D.)	14.26(2.68)	14.28(2.76)	14.06(2.10)	15(1.41)	0.13	0.875	Not Significant
NO. OF PUNCTURES	1.49(0.62)	1.38(0.52)	2.28(0.75)	1.5(0.71)	21.13	0.00	Significant
DURATION OF CENTRAL LINE	7.04(2.23)	6.85(2.04)	8.72(2.87)	4.5(0.71)	7.48	0.001	Significant

Table 2: Prevalence of central catheter-related factors

Variables	Total	Percent	Chi Square	p value	Significance
Site of catheterization					
SUBCLAVIAN VEIN	18	12.0	194.56	0.00	Significant
FEMORAL VEIN	2	1.3			
INTERNAL JUGULAR VEIN	130	86.7			
Type of Procedure					
Elective	138	92.0	105.84	0.00	Significant
Emergency	12	8.0			
Number of Punctures					
1	87	58.0	59.56	0.00	Significant
2	53	35.3			
3	10	6.7			
Duration of Central Line					
Less than or equal to 3	9	6.0	116.16	0.00	Significant
Greater than 3	141	94.0			
Side of insertion					
RT	139	92.7	109.23	0.00	Significant
LT	11	7.3			
USG/LANDMARK					
LANDMARK	127	84.7	72.11	0.00	Significant
USG GUIDED	23	15.3			
Type of Central Line					
7 FR 03 Lumen	104	69.3	102.01	0.00	Significant
7 FR 02 Lumen	43	28.7			
7 FR 01 Lumen	3	2.0			

Table-3 Variables Associated With Catheter Associated Blood Stream Infections

Variables	Incidence of CRBSI	P-value	Incidence of Exit Site Infection	P-value	Incidence of Catheter Tip Infection	P-value	Incidence of Catheter Related overall Infection	P-value
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Various Comorbidities	Yes	5/78	0.83	5/78	0.54	8/78	0.25	18/78	0.64
	No	4/72		3/72		12/72		19/72	
Hypertension with Diabetes II	Yes	4/23	0.01	2/23	0.44	2/23	0.48	8/23	0.22
	No	5/127		6/127		18/127		29/127	
Site of insertion	IJV	7/130	0.59	8/130	0.52	18/130	0.81	33/130	0.69
	SCV	2/18		0/18		2/18		4/18	
	FV	0/2		0/2		0/2		0/2	
Type of insertion	Elective	9/138	0.36	6/138	0.07	20/138	0.16	35/138	0.50
	Emergency	0/12		2/12		0/12		2/12	
No. of puncture	01	3/87	0.10	4/87	0.56	8/87	0.14	15/87	0.04
	02	4/53		4/53		11/53		19/53	
	03	2/10		0/10		1/10		3/10	
Technique	Landmark	7/127	0.55	7/127	0.82	18/127	0.48	32/127	0.72
	USG guided	2/23		1/23		2/23		5/23	
Type of central line	7 Fr 01 lumen	1/3	0.06	0/3	0.09	0/3	0.71	1/3	0.32
	7 Fr 02 lumen	4/43		5/43		5/43		14/43	
	7 Fr 03 lumen	4/104		3/104		15/104		22/104	
Duration of catheter	Less than & equal to 3 days	0/9	0.43	1/9	0.43	1/9	0.84	2/9	0.86
	> 3 days	9/141		7/141		19/141		35/141	

DISCUSSION

Central Venous Catheters are routinely used medical devices for treatment of chronically and critically ill patients. Blood stream infections related to Central Venous Catheterization are a cause of significant morbidity and mortality. The cost of CVC-associated BSI is substantial, both in terms of morbidity and in terms of financial resources expended.

A total of 150 patients with 1056 catheter days were included in our study. The rate of infections associated with Central Venous Catheterization was 35.03 per 1000 catheter days. In this study, out of 150 patients with CVCs, 37 were having Catheter associated infections with incidence of 24.66%. Incidence of exit site infections was 5.33% (7.57 per 1000 catheter days), catheter tip infections was 13.33% (18.93 per 1000 catheter days) and CRBSI was 6% (8.52 per 1000 catheter days).

In present study out of 150 patients catheter colonization rate of (29/150) 19.33% was seen. CRBSI rate of (9/150) 6% or 8.52 per 1000 catheter days was observed (all 09 organisms were common among blood culture as well as CVC tip culture). The incidence of CRLI was 18.66% or 26.51 /1,000 catheter-days in our study.

Catheter colonization rate was 62.5% and CRBSI rate was 12.5% or 10 per 1000 catheter days in a study done by Rupam Gahlot et al. [7] Catheter colonization rate was 57.6% and CRBSI rate was 9.26 per 1000 catheter days in a study conducted by Chopdekar et al.[8] CRBSI rate was 4.01 per 1000 catheter days in a study conducted by Pawar et al.[9] CRBSI rate was 20.06 per 1000 catheter days in a study conducted by Almuneef et al. [10]

The incidence of CRBSI and CRLI were 2.79 and 4.43% or 6.05 per 1,000 catheter-days, respectively in a study conducted by Leonardo Lorente et al. [11]

World over, the reported incidence of exit site infections vary from 6 to 15%, catheter tip infections from 4 to 15% and of CRBSIs from 1 to 13%.[11]

According to the literature, rate of CRBSI is 1% to 13%.[1,9]

Our results are more or less similar with the study conducted by Chopdekar et al.[8] ,Rupam Gahlot et al. [7]

LIMITATION

The population in the present study sample includes only surgical ICU patients and number of emergency catheter insertion was small. More prospective studies of sufficient size and to address all potential risk factors will enhance our

understanding of the pathogenesis of CVC-related BSI and guide to develop more effective strategies for their prevention.

CONCLUSION

Our study revealed a total of 24.66% of CVC associated infections. This included exit site infections (5.33% or 7.57 per 1000 catheter days), catheter tip infections (13.33% or 18.93 per 1000 catheter days) and CRBSI (6% or 8.52 per 1000 catheter days).

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