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Original Research Article

A Prospective study on central venous catheter related blood stream infections in surgical patients

Ninesh J Shah[1], Jignasa Rathva[2], Chirag Parikh[3*]

[1] Associate Professor, Department of Surgery, Sir Sayajirao General Hospital and Medical College, Baroda, Gujarat, India

[2]Senior Resident, Department of Surgery, Sir Sayajirao General Hospital and Medical College, Baroda, Gujarat, India

[3]Associate Professor, Department of General Surgery, Parul Institute of Medical and Surgical Research, Wadhodia, Vadodara, Gujarat, India

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Abstract

Introduction: Vascular catheter related infections are the leading cause of nosocomial blood stream infections and associated with significant mortality and morbidity. This study is carried out to know the central venous related blood stream infections in surgical patients. **Materials & Methods:** The present study was carried out in the Department of Surgery, Sir Sayajirao General Hospital and Medical College, Baroda. It was a prospective study of total of 72 patients who had undergone Central Venous Catheterisation. The study was carried out from October 2017 to November 2018.**Results:**Most of the patients were in the age group of 30-50 years and males outnumbered females in all age group. There was no statistically significant difference between emergency and elective procedure of the CVC insertion. Number of attempts in CVC insertion was found to be statistically significant with. Tip colonization (p value - 0.0465) and BSI (p value-0.031). Number of lumens in CVC was found to be statistically significant with regards to tip colonization (p value-0.0449) and BSI (p value-0.0243). Highest mortality occurred within 1-10 days of hospital stay. There has been statistically significant difference between the number of days of CVC in situ and catheter colonization and BSI.**Conclusion:** we can conclude that our findings helps to implement Educational, training of health care workers, and adherence to standardized protocols for insertion and maintenance of CRBSI catheters significantly reduced the incidence of catheter-related infections and represent the most important preventive measures.

Keywords: Central venous, Catheter, Blood streams infections, Surgical patients.

Introduction

Central venous catheter (CVC) related blood stream infection (CRBSI) was defined as two positive blood cultures obtained from different sites peripheral veins with clinical evidence of sepsis and with no apparent source of septicaemia except positive blood culture[1].The diagnosis of central venous catheter related blood stream infection (CRBSI) is often suspected clinically in patient using a central venous catheter who present with fever or chills, unexplained hypotension.

**Correspondence*
Dr. Chirag Parikh
Associate Professor, Department of General Surgery, Parul Institute of medical and surgical Research, Wadhodia, Vadodra, Gujarat, India.
E-mail: drchiragms@yahoo.co.in

Mild symptoms include malaise and nausea and severe symptoms high grade fever with rigors, hypotension, vomiting and changes in mental status in setting of a normal catheter exit site or tunnel on physical examination. Exit site infection is indicated by the presence of erythema, swelling, tenderness and purulent drainage around the catheter exit and the part of tunnel external to the cuff[2,3].Central venous catheters are the risk of developing local as well as systemic infectious complication like local insertion site infection, central venous catheter related blood stream infection, endocarditis, septic endocarditis, metastatic infection and serious complication like bacteraemia sepsis and death[4].

Aims

To Study

- The Incidence of central venous catheter related bacterial infection in surgical patients.
- Bacterial Colonization of central venous catheter.

Objectives

- Correlation between duration of insertion of catheter and catheter related blood stream infection.
- Correlation between number of catheter lumens and catheter related blood stream infection.

Definition

- Catheter Colonization is defined by growth of an organism from the catheter tip in a patient without clinical symptoms of sepsis.
- Bacteraemic catheter-related infection (often also referred to as CR-BSI) is defined as isolation of the same organism from catheter tip and a peripheral blood culture.

Material and Methods

The present study was carried out in the Department Of Surgery, Sir Sayajirao General hospital and Medical College, Baroda. It was a prospective study of total of 72 patients who had undergone Central Venous Catheterisation. The study was carried out from October 2017 to November 2018.Statistical analysis of the data for various parameters was done using the software nMaster 2.0

Significance of data was judged by p-value.

p-value of >0.05 was considered as non significant

p-value of <0.05 was taken as significant

The section presents the results of various aspects of variables.

Inclusion criteria

All patients with CVC in situ in surgical wards, surgical intensive care unit (SICU) and burns ward.

Exclusion criteria

Patients having bleeding diathesis were excluded.All patients in whom CVC insertion was done were included in study. The following parameter regarding CVC were recorded, Indication of CVC insertion, Emergency/ Elective procedure, Site of CVC insertion, Number of attempts, Total duration of CVC in situ, Triple lumen/Double lumen/single lumen , Blood culture sent on which day and its Organism and Sensitivity, Catheter tip culture and Sensitivity, duration of stay in ICU, hospital and mortality.

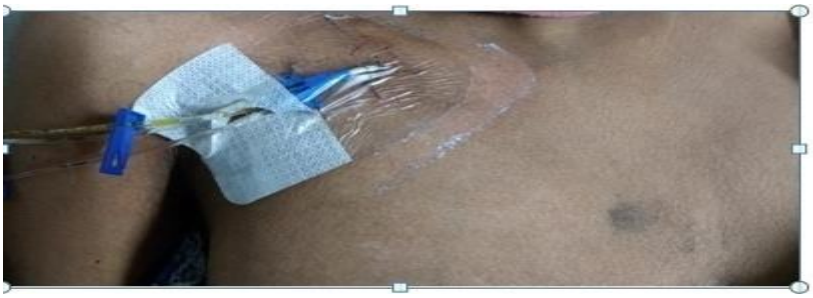

Fig. 1: Central line in Situ (Right Subclavian)

Blood culture: Two peripheral blood cultures were done if patients had clinical features suspicious of bloodstream infection like undetermined fever or hypothermia, chills, rigors, tachycardia, tachypnoea and hypotension.In case of patients having none of above symptoms, blood cultures were sent on the day of removal of central venous catheter; before removal of CVC.Blood culture was taken under strict aseptic precautions by wearing two pairs of gloves. The part of skin was prepared by cleaning with spirit first, betadine and then spirit again and waiting for one minute. One pair of gloves was removed and then 5ml blood was collected in glucose broth/Hartley broth/Brain heart infusion broth (depending on availability) in ratio of 1:10 and sent to microbiology laboratory in Sir Sayajirao General hospital.The samples were incubated for 18 to 24 hr at 37 ^{0} C and sub cultured on 1st day on solid media Macckonkey and brain heart infusion agar. If cultures show growth of organism on 2nd day, sensitivity was done by KIRBY BOUR (DISC DIFFUSION) method. If subcultures show no growth on 1st day, samples were subcultured on 3rdday and sensitivity was done.If subcultures show no growth again, the samples were subcultured on 6thday. If cultures show no growth of organisms, it was reported as no organism isolated.The above procedure was not followed and samples were subcultured immediately if

media showed turbidity, Haemolysis, Bubbling, Colony on clot.

Fig 2: Blood sample in Glucose broth (Transport Media) &Mac'konkey agar showing Klebsiella sp. Growth of blood culture

Catheter tip: The distal 5cm of the CVC was collected aseptically in sterile (universal) container and transported within 2-4 hrs to the laboratory for culture.The catheter tip was rolled on Macconkey agar and entire tip was cultured in brain heart infusion broth, incubated at 37^0c for 18-24 hours and subcultured on MacConkey agar and brain heart infusion agar.The catheter tip was not removed till the reports of blood cultures were available. Till then, high dose of empirical antibiotics like piperacillin and tazobactum or meropenem was started. After receiving the blood culture reports, antibiotics were changed according to the sensitivity.If patient did not show clinical and laboratory signs of improvement after change of antibiotic in 48-72 hours, the catheter was removed and tip was sent for culture and sensitivity .

Fig 3 : CVC tip in sterile container &Nutrient agar showing *Pseudomosas* growth of central line tip culture.

Statistical analysis

- Statistical tests used include chi-square test.
- Descriptive statistics (frequency % mean standard deviation).

Results

The results are as follows.

Demographic data

Table 1: Distribution of patients according to their age and sex

Age(years)	Sex		Total
	Male	Female	
15-30	12	7	19
30-50	22	10	32
>50	13	8	21
Total	47	25	72

In our study male patients were 12 and female patients were 7 in agegroup between 15-30 years, male patients were 22 and female patients were 10 in age group between 30-50 years and male patients were 13 and female patients were 8 in >50 years of age. Total 19 Patients in age group 15-30 years, 32 patients in age group between 30-50 years of age, total 21 patients in age >50years.Most of the patients were in the age group of 30-50 years and males outnumbered females in all age group.

Table 2: Correlation between Number of Attempts of CVC insertion, Catheter tip colonization and BSI

Totalnoofattempt	No of patients	Percentage (%)	Tip culture	Blood culture	P value	
					Tip culture	Blood culture
1	3	4.17	0	0	0.0465	0.031
2	30	41.67	4	3		
3	39	54.17	19	18		

In 39 (54.17%) patients successful CVC insertion was done in three attempts, in 30 (41.67%) patients in two attempts and in 3 (4.17%) patients at first attempt. Number of attempts in CVC insertion was found to be statistically significant with Tip colonization (p value - 0.0465) and BSI (p value-0.031).

Table 3: Correlation between Number of Lumen in CVC catheter tip colonization and BSI

No. Of lumen	No of patients	Tip culture	Blood culture	P value	
				Tip culture	Blood culture
1	5(6.94%)	1	0	0.0449	0.0243
2	15(20.83%)	0	0		
3	52(72.22%)	22	21		

In our study triple lumen catheter was inserted in 52(72.22%) patients, double lumen in 15(20.83%) and single lumen in 5(6.94%) patients. Number of lumens in CVC was found to be statistically significant with regards to tip colonization (p value-0.0449) and BSI (p value-0.0243) .

Table 4:Patients distribution

BURNS	7
SICU	35
WARDS	30

CVC insertion was done in 7 patients of burns, 35 SICU Patients and in 30 ward patients

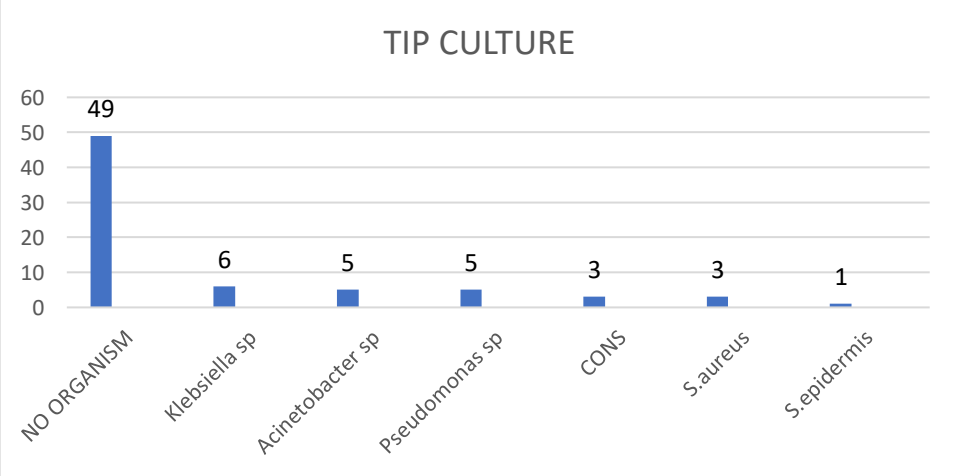

Fig 4: Tip culture

In our study, no organism was isolated in tip culture of 49 patients (68.05%). Among positive catheter tip culture most common was *Klebsiella sp.* in 6 patients (8.33%),followed by *Acinetobacter sp.* and *Pseudomonas sp.* in 5 (6.94%) patients, *S.aureus and Coagulase negative staphylococci* (CONS) in 3 patients (6.94%),and *S,epidermis* in 1 (1.39%) patients.

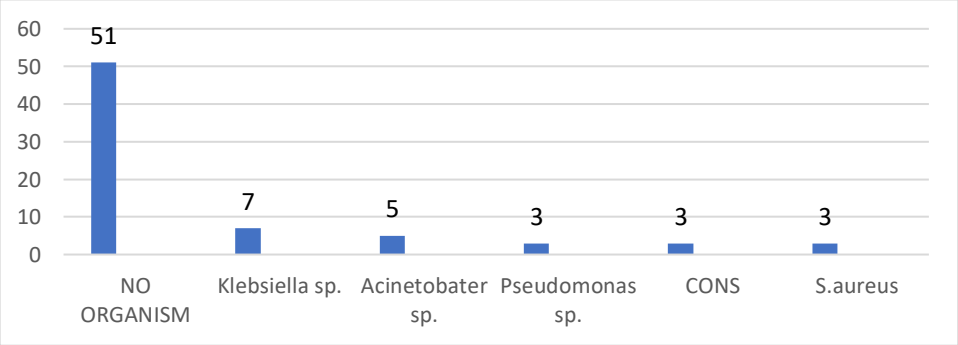

Fig 5: Blood culture

In our study no organism was isolated in blood culture of 51 patients (70.83 %). Among the positive blood culture most common was *Klebsiellasp.* in 7 (9.72%) patients, followed by *Acinetobacter sp.* in 5 (6.94%) patients , *Pseudomonas sp.* in 3(4.16%) patients, *S.aureus* and CONS in 3 patients.

Table 5: Correlation between tip culture and blood culture

Organisms	Tip culture	Blood culture	CRBSI
Klebsiella Sp	6	7	4
Acinetobacter Sp	5	5	2
Pseudomonas Sp	5	3	2
Coagulase Negative Staphylococci (CONS)	3	3	3
S.Aureus	3	3	3
S.Epidermis	1	-	-
Total positive culture	23	21	14

Klebsiella sp was isolated in tip culture of 6 patients, in blood culture of 7 patients and common in 4 patients. *Acinetobacter sp*in tip culture of 5 patients, in blood culture of 5 patients and common in 2 patients. *Psedomonas sp*was isolated in tip culture of 5 patients, in blood culture of 3 patients and common in 2 patients,

CONS tip culture of 3 patients, in blood culture of 3patients and common in 3 patients. *S.aureus* in tip culture of 3 patients, in blood culture 3 of patients, *S.epidermis* in tip culture of 1 patients and none in blood culture.

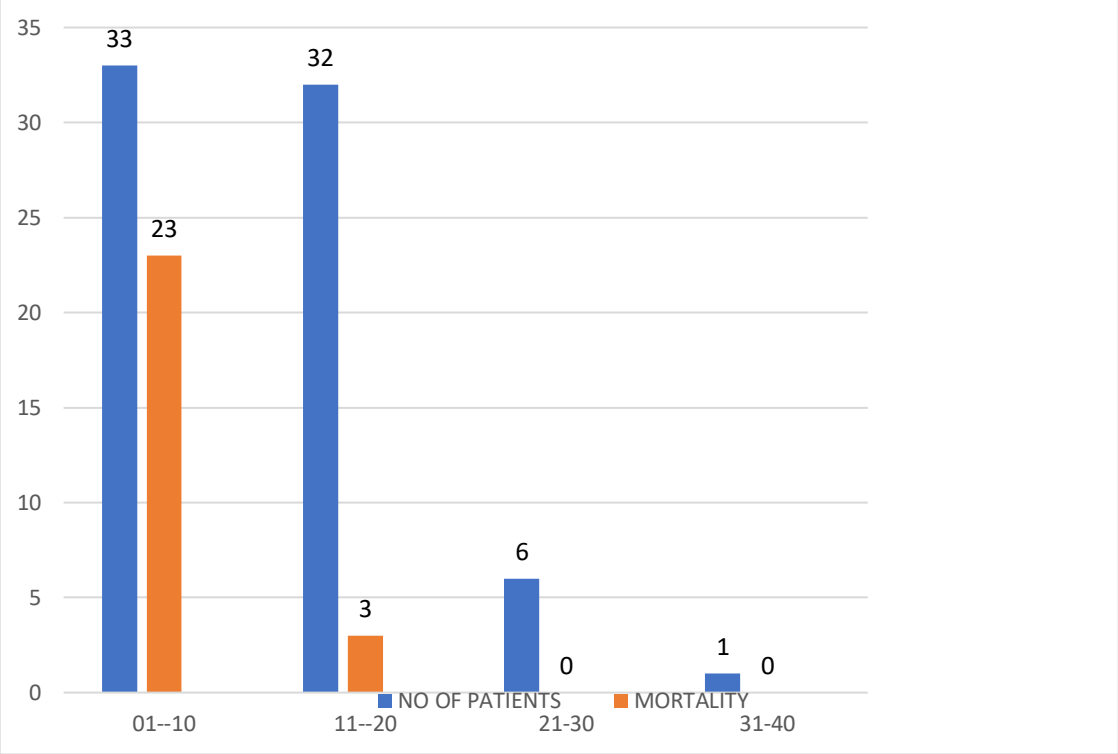

Fig 6: Hospital stay and mortality

Average hospital stay of the patient was 12.5 days. Maximum hospital stay was for 32 days and minimum hospital stay was for 3 days. Highest mortality occured within 1-10 days of hospital stay. Out of which 12 patients died because of septicaemia and 14 died due to severe intracranial injury in case of head injury patients. In our study 12 patients expired due to septicaemia out of which 8 patients expired before receiving sensitive antibiotic within 5-7 days and other 4 patients expired after starting the sensitive antibiotic within 8-14 days. Out of 4 patients we removed CVC in 3 patients due to no improvement after starting sensitive antibiotic after 48-72 hours. There has been statistically significant difference between the number of days of CVC in situ and catheter colonization and BSI.

Discussion

Venous catheters are the most frequently used indwelling medical devices and have become necessary tools for the successful treatment of patients with chronic or critical illness. Placement of these catheters however has an associated risk of morbidity and mortality. In most cases, this is outweighed by the benefit gained, especially when long-term access to the central venous system is needed. Extensive experience with this technique has lead to the recognition of infectious complications that may result from its use and factors affecting infection rate.Thus, the definitive diagnosis of CRBI can be made only by using a combination of clinical signs and symptoms together with the culture of the catheter. A prominent problem in detecting infection of intravascular catheters is the difficulty in distinguishing infection from contamination.

1. Indication of CVC and Type of Procedure

In our study of 59(81.94%) patients, CVC insertion was done as emergency procedure mostly due to poor IV access where as an elective procedure in 13(18.05%) patients for administration of TPN.There was no statistically significant difference between emergency and elective procedure of the CVC insertion.In the

study carried out by the Parameswaran R et al[3] the indication was for giving IV fluids and antibiotic, Chemotherapy. In the study carried out by Harsha V Patil et al[4] CVC insertion in25(46.29%) patients were done as emergency procedures and 29(53.70%) patients as elective procedures. (p value=0.02).

2. Site, No of attempts, No lumen and Duration of CVC

In our study we inserted CVC in Right subclavian vein in 67(93.05%), right femoral vein in 3(4.17%), right internal jugular in 2(2.78%) patients. In the study conducted by Parameswaran R et al, CVC insertion was done in Basilic vein in 25(23.14%), Femoral vein in 36(33.33%), jugular vein in 24(22.22%),Subclavian vein in 23(21.29%) patients[3]. In our study, in 39(54.17%) patients successful CVC insertion was done in three attempts, in 30(41.67%) patients in two attempts and in 3(4.17%) patients at first attempt. We inserted CVC Single lumen in 5(6.94%) patients, double lumen in 15(20.83%) patients, Triple 52(72.22%) lumen patients. In our study number of attempts (p value for tip colonization 0.0465 and blood culture 0.031) and number oflumen (p value-for tip colonization 0.0449 and blood culture 0.0243) were found to be significant.In the study conducted by Harsha V et al[4] attempt of CVC insertion was done at once in 28(51.85%), in twice in 17(31.48%), in thrice in 9(16.66%) patients. Number of attempts (p value-0.002)were found to statistically significant.In the study conducted by Parameswaran R et al[3] Single lumen CVC was inserted in 25(23.14%), double lumen in 40(37.38%), Triple lumen in 43(39.81%) patients. Number of lumens (p value-0.004) were found to statistically significant.In our study, Duration of CVC in situ was for 1-10 days in 33 patients, 11-20 days in 32, 21-30 days in 6 patients, 31-40 days in 1 patient. Duration of CVC in situ (p value-for tip colonization 0.0304 and blood culture -0.0294) was found to be statistically significant with regards to tip culture and CRBSI in our study.In the study conducted by Harsha V et al[4]. Duration of CVC in situ was <3 days in 16 patients and >3 days in 38 patients. Duration of CVC in situ (p value-0.02) was found to be statistically significant.Colonization of catheter tip in our study was 31.9%(23/72), where as in other study like FJ Mansur et al 56.1% (32/57), Harsha V et al[4] 27.77% -(15/54), Parameswaran R et al[3] 89.64% (83 cases/108), K Chopdekar et al[5] 57.6% (49 /85). Percentage of catheter tip colonization showed variation in different study. This may be related to variation of site of CVC insertion and institute protocol for insertion of CVC. In our study the percentage of CRBSI was 19.44% (14/72) and in other study like FJ Mansur et al 14% (25/57),Harsha V et al7.41%(4/54), Parameswaran R et al 27%(15/108), K Chopdekar et al[5] 15.3% (18/85). Post procedure local care of CVC may be a factor for variationin different studies.

5. Common organisms in Tip and Blood culture

In our study, most common organisms were *Klebsiella sp. , acinetobacter sp*, CONS , *Pseudomonas sp* .and *S.aureus*. In the study conducted by FJ Mansur et al most common species isolated were *Pseudomonas sp., Aceinetobacter sp, S. aureus, Enterococcus, Staphylococcus epidermidis* and *Candida sp.*I n study conducted by Harsha V et al most common species isolated were CONS, *S. epidemidis (45%), S. haemolyticus, S. saprophyticus, S. epidemidis* and *S. haemolyticus.* In study conducted by Parameswaran R et al most common species isolated were S. *aureus* , *coagulase negative Staphylococci* and *Candida*.In study conducted by K Chopdekar et almost common species isolated were *Coagulase-negative Staphylococci, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *non-albicans Candida*[5].

6. Susceptibility to antibiotics

In our study, *Klebsiella sp.* (most common isolated) were more sensitive towards levofloxacin and cefuroxime.

Acinetobacters sp. were more sensitive towards imipenem, amikacin and colistin.*Pseudomonas sp.* were more sensitive towards piperacillin + tazobactum, cefotaxime+sulbactum, meropenem, colistin and aztreonam.CONS were more sensitive towards Vancomycin, linezolid, clindamycin and erythromycin. *S.areus* were more sensitive toward levofloxacin, gentamycin and vancomycin.In study of FJ Mansur et al study showed Methicillin resistance *S. aureus* were 60%,Imipenem resistant *Pseudomonas sp.* and extended spectrum β lactamase producing *Enterobacteriaceae. Acinetobacter* were resistance to imipenem[1].In study of Harsha V et al Staphylococcal showed resistance to penicillin and ampicillin & susceptibility to amikacin, doxycycline and amoxycillin/ clavulanic acid,*S. Saprophyticus* showed resistance to penicillin and cotrimoxazole& susceptibility to amoxycillin/clavulanic acid and ciprofloxacin , *K. pueumoniae* isolates were resistant to all the antibiotics except amikacin and ciprofloxacin, *E. coli* was resistant to all the antibiotics except amikacin and cefotaxim, CONS were resistant to erythromycin, penicillin, oxacillin, cephalothin and sensitive to vancomycin.In study conducted by Parameswaran R et al MRSA and MRCONS isolates

were sensitive to vancomycin, teicoplanin and linezolid; *Pseudomonas aeruginosa* sensitive to cefoperazone-sulbactum, piperacillin-tazobactum, ticarcillin-clavulanic acid and meropenem and resistance to single antibiotics; the *Escherichia coli* were sensitive to cefuroxime and meropenem[3].In study conducted by K Chopdekar et al shows multidrug-resistant to more than two different classes of antibiotics[5].In our study 12 patientsexpired due to septicaemia out of 8 patients expired before receiving sensitive antibiotic and other 4 patients expired after starting the sensitive antibiotic . 14 patients expired due to sever intracranial injury.Out of 21 patients found positive on blood culture 6 patients were treated according to their sensitivity and they all responded wells to it, but this was not found to be true in case of tip colonization of bacteria.Catheter colonization did not appear to have direct bearing on blood stream infection.

Conclusion

The following conclusions can be drawn from the study.

- In our study, Incidence of tip colonization was to be found 31.94%.
- Incidence of positive blood culture was to be found 29.16% in our study.
- CRBSI was to be found 19.4% in our study.
- The most common organisms isolated in blood culture and tip culture was klebsiella .
- Increased number of CVC attempts were found to be associated with increased number of tip colonization (p value-0.0465) and CRBSI (p value-0.031).
- There was statically significant difference in tip colonization (p value-0.0449), CRBSI (p value-0.0243) and numbers of lumen.
- More the number of days of CVC in situ was associated increased catheter tip colonization (p value-0.0304) and CRBSI (p-value-0.0294).
- The most common indications for insertion of CVC were poor peripheral IV access and for TPN.
- Type of the procedure (Emergency /Elective) was not associated with occurrence of tip colonization (p value-0.811) and CRBSI(p-0.54) in our study.
- Most preferred site for CVC insertion was theright subclavian vein .
- Most common cause ofdeath being septicaemia 19.5 %(12/72) and severe intracranial injury16.6% (14/72). Highest mortality occurred within 1-10 days.

Source of Support:Nil
Conflict of Interest: Nil

Limitations of the study

1. The choice of CVC according to number of lumen was based on the availability at time of procedure.
2. Right subclavian vein was the most common site for CVC insertion and other site were used infrequently as we are more accustomed to it.
3. The susceptibility of isolated organisms was done according to availability of disc and all antibiotics were not tested for all organisms in all patients.

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