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Frequency of Catheter Related Blood Stream Infections due to Indwelling Temporary Double Lumen Catheter with Respect to Duration of Catheterization in Hemodialysis Patients

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ABSTRACT

Background: Temporary hemodialysis catheters are an important means of gaining immediate vascular access. Catheter related blood stream infection (CRBSI) is the most important complication limiting its use. Frequency of CRBSI increases with duration of catheterization. **Objective:** To find the frequency of catheter related blood stream infections due to indwelling temporary double lumen catheter with duration of insertion in hemodialysis patients. **Materials and methods:** This is a hospital based cross-sectional study which includes 40 renal failure patients requiring dialysis with temporary hemodialysis catheter who were found to have CRBSI. The frequency of catheter related blood stream infections due to temporary double lumen catheter in relation to duration of insertion in hemodialysis patients was calculated. **Results:** Mean duration of catheterization till CRBSI developed was 16.97±8.56 days, although, it varied from 7 to 37 days. The frequency of CRBSI at 1st week , 2nd week, 3rd week, 4th week and more than 4 weeks was 4 (10%), 14 (35%), 11 (27.5%), 4 (10%) and 7 (17.5%) respectively. A sub-group analysis of frequency of blood stream infections with respect to duration of catheterization amongst diabetics against non-diabetics, internal jugular (IJ) against subclavian (SC) vein site, optimal against sub-optimal hygienic conditions, males against females and amongst various age groups was conducted and did not show any statistically significant difference. (p value> 0.05). **Conclusion:** The frequency of CRBSI in temporary hemodialysis catheters increases with duration of catheterization and is maximum at 2nd week post catheterization. We recommend duration of catheterization should be limited to less than two weeks in hemodialysis population.

Key words: Catheter related blood stream infection (CRBSI), Temporary hemodialysis catheter, Duration of catheterization, Vascular access

INTRODUCTION

Vascular access is an essential requirement for hemodialysis. Two types of permanent accesses are used in hemodialysis: (1) native arteriovenous fistulas (AVF) (2) arteriovenous grafts.[1] The native arteriovenous fistula (AVF) is the preferred vascular access because of its longevity and its lower rates of infection and intervention.[2]

However, a significant number of patients require a temporary vascular access because of acute renal failure, slow maturation or failure of their permanent arteriovenous access or as bridging to transplantation, peritoneal dialysis or AVF maturation. In these situations, temporary catheters are used when a catheter is needed for only a short period of time and tunneled cuff catheters for longer periods. Temporary catheters can be inserted with relative ease by a bed-side procedure under local anesthesia.

From recent data of the Dialysis Outcome and Practice Patterns Study (DOPPS), it is recognized

that 15–50% of patients in Europe and 60% of patients in the US start hemodialysis treatment with a catheter as primary access. In new end stage renal patients (ESRD) patients, 48% of the patients in US and 75% of patients in Europe start hemodialysis with temporary catheters and even in prevalent patients, over a third of all have temporary catheter as a vascular access.[3,4]

Early complications of temporary catheters are puncture site hemorrhage, hematoma formation, artery puncture and spontaneous pneumothorax. The main late complications are catheter related bacteremia, and insertion site thrombosis with higher rates for subclavian vein versus internal jugular vein catherization.[5-7]

The risk factors for catheter related blood stream infections include prolonged duration of usage, a history of previous catheter-related bacteremia, recent surgery, diabetes mellitus, iron overload, staphylococcus aureus nasal colonization, old age, low hemoglobin and low serum albumin levels. [8-11]

There are no local studies available to suggest the optimum duration of temporary double lumen catheter in our hemodialysis population and circumstances. This study was conducted to find out the frequency of catheter related infections with respect to duration of insertion in hemodialysis patients.

MATERIALS AND METHODS

This hospital based cross-sectional study includes 40 renal failure patients requiring dialysis with temporary hemodialysis catheters who developed CRBSI. An informed consent was taken from all participants. This study was carried out over a 2 months period from the 1st of July 2014 till the 31st of August 2014 at the inpatient Nephrology Unit of Shaikh Zayed Hospital Lahore.

The patient's age, sex, etiology of renal failure, date of catheter insertion, site of insertion, hygienic condition of procedure and days of catheter placement till suspicion of CRBSI were noted.

Two sets of blood cultures were sent in all patients; one from catheter and second from peripheral vein. In the event of catheter removal, the catheter tip was sent for culture and sensitivity.

Inclusion and exclusion criteria

The participants belonged to either sexes and were above the age of 18 years. All patients who were suspected of having CRBSI but found to have bacteremia due to other sources of infection like urinary tract infection (UTI), respiratory tract infection (RTI), gastrointestinal tract (GIT) infection or malaria were excluded on the base of history, examination and relevant investigations such as x-ray chest, urine complete, urine c/s, stool c/s, Typhi dot and ICT Malaria.

Definitions

Diabetic

Patients were said to be diabetic if they were known to be on treatment for diabetes or fasting blood sugar level > 126.

Hygienic conditions of Double lumen placement

Double lumen catheter was said to be placed in optimal hygienic conditions if it was placed in a dedicated procedure room, with operator using sterilized gown, eye towel and instruments.

CRBSI

Presence of fever and Total Leucocyte Count (TLC) count > 11000 or < 4000 white blood cells/mm^3 in patients with indwelling temporary hemodialysis catheter provided other sources of infection were excluded as mentioned above.

Culture Positive CRBSI

Patients having CRBI with positive blood cultures.

Data analysis

All data was entered in the Statistical Package for Social Sciences (SPSS) version 20. Quantitative data like age, TLC and duration of catheter in situ till infection were presented as means and standard deviations (SD). Qualitative data like gender, number of diabetics/non-diabetics, catheter sites, hygienic conditions, positive blood culture and organism isolated were presented as frequencies and percentages. Comparison of frequency of CRBSI in different groups with respect to duration of catheterization was done by chi square test. A p-

value of 0.05 or less than 0.05 was taken as significant.

RESULTS

Amongst the 40 participants included in this study 26 were males (65%) while 14 were females (35%). The patients had a mean age of 45.63±11.88 years. The age range varied from 23 years to 67 years. 23 (57.5%) patients were diabetics and 17 (42.5%) were nondiabetics. The site of double lumen catheter insertion was internal jugular in 29 (72.5%) patients and subclavian in 11 (27.5%) patients. 26 (65%) catheters were placed under optimal hygienic conditions while 14 (35%) were placed under sub-optimal hygienic conditions. Mean TLC was 17002±11011.21 white blood cells/mm^3. The TLC varied from 2300 to 63000 white blood cells/mm^3. The baseline variables are presented in Table 1.

Table 1: Patient data.

Variable	N=40
Age (years) Mean±SD	45.63 ±11.88
Sex	
Male	26 (65%)
Female	14 (35%)
TLC count Mean±SD	17002±11011.21
Etiology of renal failure	
Diabetic	23(57.5%)
Non-Daibetic	17(42.5%)
Site of double lumen catheter insertion	
Internal jugular	29(72.5%)
Subclavian	11(27.5%)
Hygienic conditions of procedure	
Optimal	26 (65%)
Less than optimal	14 (35%)

Out of 40 CRBSI, blood cultures were positive in 10 (25%) patients and negative in 30 (75%) patients. Staph aureus was seen in 4 (10%) patients, pseudomonas aeruginosa in 3 (7.5%) patients, coliform spp in 3 (7.5%) patients and no growth detected in 30 (75%) patients. Among 10 culture positive CRBSI patients, 6 (60%) patients were diabetics and 4 (40%) were nondiabetics. The mean duration of catheterization till CRBSI developed was 16.97±8.56 days. The duration of catheterization till CRBSI developed varied from 7 to 37 days.

Table 2: Frequency of CRBSI in different groups of patients with respect to duration of catheterization.

	Frequency of CRBSI (n=40)	Internal Jugular catheter	Subclavian vein catheter
1st week	4 (10%)	2 (6.9%)	2 (18.2%)
2nd weeks	14 (35%)	9 (31%)	5
3rd weeks	11 (27.5%)	9 (31%)	2 (45.2%)
4th weeks	4 (10%)	4 (13.8%)	0
> 4 weeks	7 (17.5%)	5 (17.2%)	2 (18.2%)

Table 3: Infection rates among different groups with respect to duration of catheterization.

Parameter	Infection rates among different groups with respect to duration of catheterization		
	<2 weeks	>2 weeks	P value
Site			
Internal jugular	11(37.93%)	18(62.07%)	.135
Subclavian	7(63.64%)	4(36.36%)	
Etiology of renal failure			
Diabetics	12(52.17%)	11(47.83%)	.289
Nondiabetics	6(35.29%)	11(64.71%)	
Hygienic conditions			
Optimal	9(34.62%)	17(65.38%)	
Less than optimal	9(64.29%)	5(35.71%)	.503
Age			
<40 years	6 (54.55%)	5(45.45%)	.347
>40 years	12(41.38%)	17(58.62%)	
Sex			
Males	10(38.46%)	16(61.54%)	.257
Females	8(57.14%)	6(42.86%)	

To find out the frequency of CRBSI with respect to duration of catheterization, we divided the patients into 5 groups depending upon weeks of catheterization as shown in Table 2. We compared the frequency of CRBSI with respect to duration of catheterization among these groups and among diabetics with nondiabetics, IJ with SC site, optimal with less than optimal hygienic conditions, males

with females and age <40 years with >40 years but no statistically significant difference was found (p value> 0.05) (Table 3) except the duration of catheterization, which was found to be an important factor leading to CRBSI.

DISCUSSION

After cardiovascular disease, infection is the second most common cause of death in patients with ESRD.[12] Old age, diabetes, low serum albumin, temporary vascular access, and dialyzer reuse are associated with increased risk of infection.[13]

CRBSI is a major cause of morbidity and mortality in patients with end-stage renal disease treated with hemodialysis. The incidence of bacteremia is 10 times greater with hemodialysis catheters than either fistulas or synthetic grafts.[14,15]

Compared to tunneled cuffed haemodialysis catheters, temporary untunneled catheters are associated with much higher rates of CRBSI.[4] An important risk factor for CRBSI is prolonged duration of use.[16,17]

Our study showed highest frequency of CRBSI at 2nd week (35%) post catheterization. In IJ catheters highest frequency of CRBSI was seen at 2nd and 3rd week (31%) while in subclavian vein catheters highest frequency of CRBSI was at 2nd week (45.5%). In a study by Oliver MJ et al the frequency of CRBSI at the internal jugular site was 5.4% up to three weeks of use, but increased to 10.3% by the fourth week.[18] Hence the frequency of CRBSI was much higher in our study at 2nd week of catheterization.

The mean duration of catheterization till CRBSI developed was 16.97 days and it varied from 7 to 37 days. Altaee KHA et al also studied CRBSI among temporary HD catheters. Mean duration of catheterization till CRBSI developed was 43.6 days, ranging between 7 and 110 days in his study.[19]Hence in our patients the CRBSI developed much earlier.

The reason for high frequency of CRBSI at second week and less duration of catheterization till CRBSI develops could be multifactorial. First of all, all the included patients were not admitted in the ward till the development of CRBSI, so sterile catheter handling and dressing care may not be assured. Secondly patients' personal hygienic conditions may not be as good as in other studies because of lower socioeconomic status. Thirdly catheter handling for dialysis may not be strictly hygienic as most of the patients get dialyzed in remote areas where dialysis staff may not be stringent in aseptic catheter handling.

We found no statistically significant difference in the frequency of CRBSI with respect to days of catheterization among different sub groups. This finding was similar to that seen by Oliver et al.[18]

Although the signs and symptoms developed in all the 40 patients blood cultures were positive only in 25% of patients in our study. This may be due to improper sampling and culture techniques and prior use of antibiotics.

To control this high infection rate, we should follow full sterile barrier during the vascular access placement and do aseptic catheter dressing, conduct educational programs for the physicians-in-training and technical staff, use antiseptic and antimicrobial coated or impregnated catheters, use antibiotic-anticoagulant locks and limit the duration of use of temporary catheters.[20]

The limitations of this study are that this is a single center, nonrandomized study. The sample size was small and diagnostic criteria for CRBSI was not positive blood culture. Further larger studies are required to better stratify the frequency of CRBSI in temporary hemodialysis patients with respect to duration of catheterization.

CONCLUSION

The frequency of CRBSI in temporary hemodialysis catheters increases with duration of catheterization and is maximum at 2nd week of catheterization. Hence duration of catheterization should be limited to less than two weeks in the hemodialysis population.

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