International Journal of Pharmacy and Pharmaceutical Sciences

ISSN- 0975-1491 Vol 3, Issue 3, 2011

Research Article

INCIDENCE OF BACTEREMIA ASSOCIATED WITH CENTRAL VENOUS CATHETER IN PATIENTS ON HEMODIALYSIS

POOJA GUPTA, REENA SET, KALPANA MEHTA, JAYANTHI SHASTRI

Dept. of Microbiology AIMSR- Bathinda 151001, Dept. Of Microbiology, Dept. of Nephrology, Dept. of Microbiology T.N.M.C and B.Y.L Nair Hospital Mumbai. Email: dr_poo1953@sify.com

Received: 24 March 2011, Revised and Accepted: 25 April 2011

ABSTRACT

The use of temporary hemodialysis catheters is often complicated by infectious or mechanical complications which are responsible for considerable morbidity and mortality in hemodialysis patients.

Aims: To study the incidence of infections associated with Central Venous Catheter (CVC) access and incidence of secondary bacteremia in hemodialysis patients. Also we studied the risk factors and bacteria, commonly associated with CVC infection in hemodialysis patients.

Methods: We conducted a prospective study in Nephrology department at a tertiary hospital. Prospective surveillance for hemodialysis catheter related blood stream infections (CRBSI) was performed in hundred patients in whom CVC was the access. Blood culture and Maki's semi-quantitative method for catheter tip were used for processing.

Results : Catheter related bacteremia(CRB) was diagnosed in 15 patients(15%). Secondary bacteremia was seen in 5 patients(5%); in 4 patients the source was urinary tract. Age and sex did not alter the risk while diabetes, hypoalbuminemia and anemia contributed to increased risk. Staphylococcus aureus and Coagulase negative Staphylococcus accounted for majority of CRB episodes, the other being Gram negative organisms like Pseudomonas Spp. and E.coli. All S.aureus isolates were methicillin sensitive i.e. were MSSA. Secondary bacteremia was mainly due to E.*coli.* **Conclusion:** Hemodialysis catheters had a significant infection rate with Gram positive organisms being responsible for majority of CRBSI (catheter related blood stream infections) in our hospital.

Keywords: Bacteremia, CVC, Hemodialysis, CRBSI.

INTRODUCTION

Hemodialysis (HD) acts wonders by improving the quality of life in patients of end stage renal disease. HD machine removes wastes from the blood stream and regulates the body's fluid and chemical balances.

Vascular access acts as the bridge between the patient and the machine circuit, hence it is called the "Achilles heel of hemodialysis".[1]

Clinical data confirm that CVC are a major source of bacterial colonization and infection as compared to other access types.

Catheter related bacteremia (CRB) is the most significant infectious complication of HD catheters, occurring in 5-18% of catheters and results in patient's morbidity or premature catheter removal.[2] Hence we conducted a prospective study on HD patients with CVC to assess the incidence, associated risk factors and causative organisms of CVC associated infections.

MATERIALS AND METHODS

The present study was a prospective analysis of infection rates in HD unit in T.N.Medical College and B.Y.L Nair Hospital, Mumbai, a large tertiary care hospital carried out after obtaining approval of the institutional ethics committee. While patients with CVC were included, those with AV fistula or AV graft were excluded. Hundred consecutive such patients were included in this study which was conducted over a span of nine months from July 2005 to March 2006. A special proforma was designed related to patient's details but no efforts were made to collect information about the dialysis membrane and the dialysate composition.

Catheter insertion : Temporary noncuffed catheters were inserted by the renal unit medical staff after disinfection of the catheter site with 0.5% chlorhexidine in 70% alcohol, by the Seldinger technique.[3] Later the catheter was flushed with heparin in 0.9% saline.

Sample collection

a) Blood : Samples were collected after obtaining written informed consent from patients. Blood was collected and inoculated in Hartley's broth on two occasions. First, a single sample was collected from the peripheral vein before insertion of the catheter to rule out any existing bacteremia. If positive, the patient was excluded from the study. Secondly, after 72 hours of the insertion, two 5 ml samples of blood were collected, one from the peripheral vein and the other from the catheters; the latter being collected after at least 12 hours of hemodialysis to obviate any effects of heparin. Catheter blood was collected from both the ports after cleaning them with 70% alcohol and betadine.

This was repeated in case the patient developed fever or showed any symptoms of infection.

In the laboratory, subcultures were done from Hartley's broth onto blood agar(BA) and MacConkey medium after overnight incubation at 37^0C and also on the 2^{nd}, 4^{th} and 7^{th} days and were then discarded, if negative.

Meanwhile, a check was kept on the patient's condition, regarding any fever, exit site infection and other investigations done.

b) Catheter tip : This was collected only from patients who had their catheters removed on completion of their HD sessions or in case they showed any signs of infection. Distal 5 cm of catheter segment was cut aseptically avoiding any skin contact[4]. It was placed in a sterile test tube and sent to the laboratory where it was cultured by Maki's standard semiquantitative method on BA and then put in trypticase soy broth(TSB).[4] Both were incubated overnight at 37^0C. TSB was cultured on BA and MacConkey medium. A colony count of ≥ 15 was considered significant for cultures done by Maki's method.[4] If the same organisms grew from both peripheral and CVC blood cultures, confirmation was done by the pour-plate quantitative method.[5]

Besides blood, urine was collected from all the patients. Pus and sputum samples were collected only when indicated. All isolated bacteria were identified by using standard Microbiology procedures[6] and Antibiotic susceptibility testing was done as per

the CLSI guidelines.[7] At the end of the study statistical analysis was done by the Chi square test.

Table 1: Distribution of Type of Infection

Type of Infection	No.	%
Primary	15	15.00
Secondary	5	5.00
Colonization	8	8.00
No growth	72	72.00
Total	100	100.00

Table 2: Association between site of insertion and primary infection

Site of Insertion		Primary Infection		Total
		Growth	No growth	
Internal Jugular vein	No.(%)	10(12.20)	72(87.80)	82(100)
Femoral vein	No.(%)	5(29.40)	12(70.60)	17(100)
Subclavian Vein	No.(%)	0(0.00)	1(100)	1(100)
Total	No.(%)	15(15.00)	85(85.00)	100(100)

Incidence of CRBSI was 16.5% in females as compared to 14.5% in male patients (p-0.832) as shown in **(Table 3)**

Table 3: Association between sex and primary infection

Gender		Primary infection		Total
		Growth	No growth	
Female	No.(%)	5(16.10)	26(83.90)	31(100)
Male	No.(%)	10(14.50)	59(85.50)	69(100)
Total	No(%).	15(15.00)	85(85.00)	100(10)

Our patients were divided into 15 years age group range. The maximum CRBSI incidence was 20.5% , seen in 31-45 year age group followed by 16% in 15-30 years group (p-0.686) as shown in **(Table 4)**

Table 4: Association between age and primary infection

Age in year		Primary infection		Total
		Growth	No growth	
15 to 30	No. (%)	4 (16.0)	21(84.0)	25 (100)
31 to 45	No. (%)	8(20.50)	31(79.50)	39 (100)
46 to 60	No. (%)	2(9.10)	20(90.90)	22(100)
61 to 75	No. (%)	1(7.70)	12(92.30)	13(100)
76 to 90	No. (%)	0(0.0)	1(100)	1(100)
Total	No. (%)	15(15.0)	85(85.0)	100(100)

Out of 18 Diabetic patients, 8 showed CRBSI(44.4) while it was just 8.5% in non diabetics (p-0.000112) as shown in **(Table 5)**

Table 5: Association between blood sugar and primary infection

Blood Sug		Primary infection		Total
		Growth	No growth	
High	**No.(%)**	8(44.40)	10(55.60)	18(100)
Normal	**No.(%)**	7(8.50)	75(91.50)	82(100)
Total	**No.(%)**	15(15.0)	85(85.00)	100(100)

All 15 episodes of CRBSI were seen in patients with hypo-albuminemia; incidence being 17.4% (p-0.026), this was the most salient feature of the study as shown in

Table 6: Association between albumin and primary infection

Albumin (mg/dl)		Primary infection		Total
		Growth	No growth	
<= 3.5	No.(%)	15(17.4)	71(82.6)	86(100)
> 3.5	No.(%)	0(0.00)	14(100)	14(100)
Total	No.(%)	15(15.0)	85(85.0)	100(100)

The incidence of CRBSI in patients with low haemoglobin level was 21%, this was much higher than just 5.3% in those with normal haemoglobin level (cut off>11g%) (p-0.033) as shown in (Table 7)

Table 7 Association between haemoglobin (gm%) and primary infection

Haemoglobin (gm%)		Primary infection		Total
		Growth	No growth	
7 to 11	No.(%)	13(21.0)	49(79.0)	62(100)
> 11	No.(%)	2(5.30)	36(94.70)	38(100)
Total	No.(%)	15(15.0)	85(85.0)	100(100)

RESULTS

Results were interpreted as primary, secondary bacteremia and colonization as recommended by Tokars et al.[8]

A) Incidence- the incidence of primary bacteremia (CRBSI), secondary bacteremia and colonization were found to be 15%, 5% and 8% respectively as shown in (Table 1)

B) Risk factors - femoral vein was used for catheter insertion in 17 patients as compared to Internal jugular vein (IJV) in 82 patients. CRBSI was higher (29.4%) with femoral vein usage as compared to 12.2% with IJV as shown in **(Table2)**

C. Causative bacteria- Gram positive cocci (GPC) were the most common bacteria causing 67% of of CRBSI with S.aureus and Coagulase negative staphylococcus (CONS), each causing causing equal number of infections. These findings were supported by the fact that the same organism was isolated from both JoCath tip and blood cultures of the patient. S.aureus showed 100% sensitivity to Oxacillin and Vancomycin as shown in (Figure-1).

E.*coli* was isolated from 4 (80%) out of 5 cases of secondary bacteremia with 2 isolates being ESBL (Extended spectrum beta lactamase producing) and all were 100% sensitive to Carbapenem and Ceftazidime-clavulinic acid combination as shown in **(Table 8)**

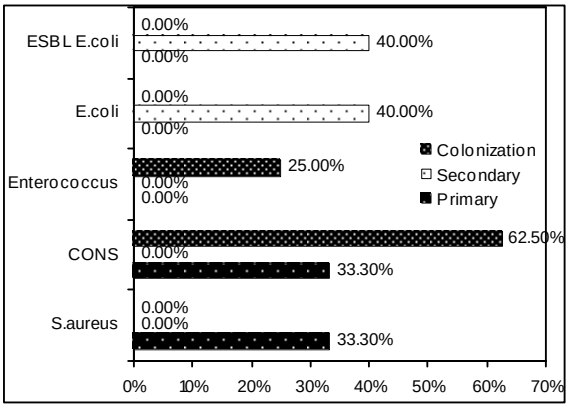

Fig. 1: Association of organisms with Different infections

Table 8: Antibiotic sensitivity pattern of gram positive Cocci (in %) isolated from primary infection

Antibiotics Tested	Bacteria			
	S aureus (n=5)		CONS (n=5)	
	Sensitive	Resistant	Sensitive	Resistant
Penicillin	0.00	100.00	40.00	60.00
Oxacillin	100.00	0.00	80.00	20.00
Cefazoline	60.00	40.00	100.00	0.00
Erythromycin	40.00	60.00	0.00	100.00
Ciprofloxacin	0.00	100.00	0.00	100.00
Vancomycin	100.00	0.00	100.00	0.00
Gentamicin	0.00	100.00	0.00	100.00

DISCUSSION

Catheter related bacteremia (CRB) is a major cause of morbidity and mortality in hemodialysis patients.[19] In the present study, definitive diagnosis of CRB was made by a combination of the clinical condition of the patient with result of blood cultures obtained from both peripheral vein and CVC, the observations being supported by catheter tip cultures.

Over the years, various workers have reported an incidence of CRBSI ranging from 5-49%. In our study the incidence of CRBSI was 15% which was similar to studies by Hung et al (21.4%)[9], Powe et al (11.7%)[10] and Kairitis et al (16%).[2]

CRBSI was higher with catheter in femoral vein as compared to IJV. This correlated with study by Oliver et al[11] thus proving femoral to be less favourable than IJV.

Sex was not found to be a significant risk factor in our study in contrast to the Saxena et al[12] study.

Our finding that age was not a risk factor for CRBSI differs from the studies which found age to be a significant risk factor[10,12] though Hoen et al[13] did not find it a significant parameter. Results related to the age factor in our study could be due to the fact that we had only 14 patients over 60 years of age.

Diabetes was found to be a risk factor for CRBSI in our study as well as in other studies.[10,12,14] Jean et al[14] had found CRBSI in 33% of diabetic patients.

Our findings of hypoalbuminemia and low haemoglobin contributing increased risk of CRBSI matched with studies of Powe et al and Hoen et al[15] respectively.

Gram positive cocci(GPC) contributed to majority of CRBSI(67%) in th present study with S.aureus and CONS accounting for 33% each, rest 33.3% by Gram negative bacilli(GNB). That GPCs were the predominant group was in accordance with studies of Abdulrahman et al [16] (77%) and Hoen et al [17] study(68%) though Saxena et al[12] showed GNB predominance (54%).

Amongst bacteria causing secondary bacteremia, E.*coli* (80%) was the commonest followed by Pseudomonas spp. (20%). All E.*coli* isolates were obtained from urine thus urinary tract was the commonest source in our study in contrast to a study that found lower respiratory tract to be the commonest one.[17,18]

one of the S.aureus isolates were Methicillin resistant i.e. all were MSSA isolates. This could be attributed to judicious use of higher antibiotics in our HD unit. To conclude, CRB with haemodialysis catheters was found to be significant with Gram positive cocci being the most dominating bacteria in our hospital.

CONCLUSION

Hence it is concluded that the catheters are still playing significant role in blood steam infections and also there should be judicious use of higher antibiotics in HD unit so as to prevent the emergence of multi-resistant strains.

REFERENCES

1. Brenner and Rector.(eds). The kidney. Saunders. Seventh edition; vol 2: 2565-2614.
2. Kairitis, L. K, Gottlieb T.(1994) Outcome and Complications of temporary hemodialysis catheters. *Nephrology Dialysis Transplant.* 14: 1710-1714.
3. Cheesebrough J.S, Finch R.G., Burden R.P. (1986) A prospective study of mechanisms of infections associated with hemodialysis catheters. *J Infect. Dis.* 1154 : 579-589.
4. Maki, D.G., Weise, C.E., Sarafin, H.W. (1977) A semiquantitative culture method for identifying intravenous catheter related infection. *N. Eng. J. Med.* 296 (23): 1305-1309.
5. Quillei, N., Audibert, G., Conroy, M.C., Bellart, P.E., Guillemin, F., Carrie, J. (1997) Differential Quantitative Blood Cultures in the diagnosis of catheter related sepsis in intensive care unit. *Clinical Infectious Diseases* 25: 1066-1070.
6. Koneman, E.W., Allen, S., Ninn, W.C., Janda, W.M.(1997) Color Atlas of Diagnostic Microbiology. 5th edition. *JB Lippincott Co*. New York.
7. Performance Standards for Antimicrobial Susceptibility Testing; Fifteenth information Supplement. (2007) CLSI. M100-S15 Vol. 25 No.1.
8. Tokars, J.L., Miller, E.R., Stein, G. (2002) New National surveillance System for Hemodialysis associated infections: initial results. CDC, Atlanta Georgia. *Am. J Infect. Control.* 30: 288-295.
9. Hung, K.Y., Yen, C.J. (1995) Infections associated with double lumen catheterization for temporary hemodialysis. *Nephrol Dial Transplant.* 10: 247-251
10. Powe, N.R., Jaar, B., Furth, S.L., Briggs, W. (1995) Septicemia in dialysis patients: incidence, Risk factors and Prognosis. *Kidney International.* 55: 1081-1091.
11. Oliver, M.J., Callery, M., Thorpe, K.E., Schwab, S.J., Churchill, D.N. (2000) Risk of Bacteremia from temporary Hemodialysis catheters by site of insertion and duration of use. *Kidney International* 58: 2543-2545.
12. Saxena, A.K., Bodh, R.P. (2005) Hemodialysis Catheter related Bloodstream Infections: current treatment options and strategies for prevention. *Swiss Med Wkly.* 135: 127-138.
13. Hoen, B., Kessler, M., Hestin, D., Mayeux, D. (1995) Risk factors for bacterial infections in chronic hemodialysis adult patients. *Nephrol Dial Transplant.*10: 377-381.
14. Jean, G., Charra, B., Chazzot, C., Laurent, G. (2002) Risk factor analysis for long term dialysis Catheter related Bacteremias. *Nephron.* 91: 399-405.
15. Hoen, B., Agnes, P., Kessler, M. (1998) EPIBACDIAL: Risk factors for Bacteremia in chronic Hemodialysis patients. *J Am Soc Nephrol*. 9: 869-876.
16. Abdulrahman, S.L., Bokhary, H.A., Ladipo, G.O. (2002) A prospective study of Hemodialysis associated infections. *J Infect Chemother*. 8: (3) 242-246.
17. European renal Association. (2002) Hemodialysis Associated infections. *Nephrol Dial Transplant*.17:(7) 72-87.
18. Ratnaja Katneni ,Hedayati S. S.(2007) Central venous catheter-related bacteremia in chronic hemodialysis patients: epidemiology and evidence-based management. *Nature Reviews Nephrology* 3: 256–266.
19. Nabi Z., Anwar S., Barhamein M., Mukdad H. A. Nassri A. E.(2009) Catheter related infection in hemodialysis patients. *Saudi Journal of Kidney Diseases and Transplantation* .20(6):1091-1095.