ORIGINAL ARTICLE

Study of Catheter-Associated Bloodstream Infection with Non-tunneled Hemodialysis Catheter and its Clinical Implication.

Shashank Bhardwaj*, Seetaram Singh*, Tushar Gupta*, Dhananjai Agrawal, Vinay Malhotra**, Rakesh Gupta***, Gigin SV*, Kavish Sharma*, Niranjan Gogoi*, Shivi******

ABSTRACT

Background: The preferred modality of vascular access for hemodialysis is an arteriovenous fistula but Non TunneledHemodialysis catheters (NTHCs) remain the preferred vascular access for hemodialysis (HD) initiation in developing countries. Central-venous-catheter-associated bloodstream infection (CABSI) is an important cause of hospital-acquired infection associated with morbidity, mortality, and cost.

Study objective: To study the incidence and microbiological spectrum of NTHC-associated bloodstream infections (CABSIs) at a tertiary care center.

Design: Prospective cohort study.

Sample: All adult (≥18 years) hemodialysis patients who underwent NTHC insertion & who met study protocol were approached for inclusion in this study.

Duration of study: One year.

Results: Data from 171 patients was analyzed in this study. Out of 171, 40 patients (23.3%) developed CABSI. Out of all the male patients, 24.2% developed CABSI, while 22.2% females developed CABSI. On statistical analysis, no significant difference was found in age and gender distribution for developing CABSI in this population. Hospital stay increased significantly in those patients who developed CABSI, with a mean duration of 19.00 ±7.09 days (P<0.001). This study showed a statistically significant association between development of CABSI and comorbidities like diabetes, hypertension, anemia and hypoalbuminemia. Overall mortality in this population was 7% (12/171). Out of 40 patients who had CABSI, 9 died (22.5%). Chi-square test showed a significant correlation of CABSI with mortality (p < 0.001).

Conclusion: Non Tunneled Hemodialysis catheters (NTHC) associated CABSI occur at a high rate with significant morbidity and mortality, especially in diabetics, hypertensive and those with anemia and hypoalbuminemia.

Keywords: Hemodialysis, Non-Tunneled, Hemodialysis catheter, CABSI

INTRODUCTION

The preferred modality of vascular access for hemodialysis is an arteriovenous fistula but Non Tunneled Hemodialysis catheters (NTHCs) remain the preferred vascular access for hemodialysis (HD) initiation in developing countries[1-3]. Central-venous-catheter-associated bloodstream infection (CABSI) is an important cause of hospital-acquired infection associated with morbidity, mortality, and cost. Consequences depend on associated organisms, underlying pre-morbid conditions, timeliness, catheter care and appropriateness of the treatment/interventions received.

Aim: To study the incidence and microbiological spectrum of NTHC-associated bloodstream infections (CABSIs) at a tertiary care center.

Methods: It was a prospective cohort study done over a period of one year. After approval by the Institutional Review Board; Ethics Committee and obtaining written informed consent, all adult (≥18 years) hemodialysis patients who underwent NTHC insertion were included in this study.

*Resident, **Senior Professor, ***, Assistant Professor, ****Senior Resident
Department of Nephrology, SMS Medical College and Hospital, Jaipur, Rajasthan
Corresponding Author:
Dr Shivi, Senior Resident,
Department of Anaesthesia, SMS Medical College and Hospital, Jaipur, Rajasthan, India, 302004
Email id: shashank.bhrdwaj@gmail.com
Phone number: 8860144064

Exclusion criteria:

1. Patient on immunosuppressing agents.

2. Patient with signs and symptoms of any systemic infections/ sepsis of other cause.

3. Central venous catheters inserted for non-dialysis indications.

Sample size: To avoid selection bias all consecutive patients who met study protocol were approached for study participation.

Data collection: All patients presenting to the hemodialysis unit with clinical features of CABSI were approached for inclusion in the study. After obtaining informed consent the demographic and clinical profiles were collected in a standard proforma. In all patients with clinical features suggestive of CABSI (see definition below), paired blood cultures (10 mL each from the peripheral blood and venous catheter hub) were obtained under sterile conditions, inoculated in culture media and immediately transported to the microbiology laboratory. Peripheral blood cultures were obtained from peripheral vein. Non tunneled hemodialysis catheter were removed and its tip was also sent for culture. Plasma samples for total and differential white cell count were sent simultaneously. Catheter salvage was not attempted.

Definitions

We followed the Centres for Disease Control and Prevention (CDC) guidelines[4] for diagnosis of central line–associated bloodstream infections. CABSI was defined as bacteremia associated with intravascular catheter with all of the following elements:

1. In the case of common commensals like coagulase-negative staphylococcus (CoNS), both catheter and peripheral blood cultures growing the same organism; in the case of all other organisms, at least one positive blood culture (catheter hub or peripheral blood or both);

2. Clinical manifestations of infection (one or more of the following: fever >38°C, chills or hypotension);

3. No other apparent source for the bloodstream infection and

4. Catheter in use within 48 hours of the CABSI.

Statistical analysis: Independent t-test and Mann–Whitney U test was used to compare means between two groups and one-way analysis of variance or Kruskal–Wallis H test was used to compare means between more than two groups, as applicable. For categorical variables, the Chi-square test was used to compare proportions. A 5% level of significance was considered significant.

RESULT

In the study period, 1073 patients underwent hemodialysis catheter insertion. Out of these, 172 patients, who met the inclusion criteria were enrolled for this study. One patient was discharged against medical advice and was thus excluded. Data from 171 patients was analyzed. Mean age of this population was 45.57 years with a standard deviation of 16.99. 57.9% of total patients were males and 42.1% were females.

Out of 171, 40 patients (23.3%) developed CABSI. Mean age of the patients having CABSI was 44.250 ±17.12 years, while in those not developing CABSI was 45.977 ±17.004 years. No statistically significant difference was found in age distribution in the two groups. Out of all the male patients, 24.2% developed CABSI, while 22.2% females developed CABSI. On statistical analysis, no significant difference was found in gender distribution as well.

Most common organism isolated was Coagulase Positive Staphylococcus aureus (40%). Other organisms isolated were Pseudomonas aeruginosa (22.5%), E. coli (15%), Klebsiella pneumoniae(7.5%), Enterobacteraerogenes(5%),Acinetobacter(5%), Enterococcus (5%) and Coagulase Negative Staphylococcus (staph epidermidis) 2.5%.

On an average, the HD catheter remained in situ for 25.92 ± 5.32 days. In patients who developed CABSI; mean days of HD catheterization before developing CABSI was 25.23 ± 5.14 while, it was 26.14 ± 5.37 days in those patients who did not have CABSI. No statistical significance was found for duration of HD catheterization prior having CABSI.

On an average, 14.743 ± 6.534 days were spend in hospital. Hospital stay increased significantly in those patients who developed CABSI, with a mean duration of 19.00 ±7.09 days ($P < 0.001$).

75 out of 171 patients (43.9%) had history of diabetes mellitus (DM). Out of 40 patients who developed CABSI, 27 had history of DM. Among 131 patients who did not develop CABSI, 48 were diabetic. Statistical analysis showed a significant association of DM with CABSI, with $p = 0.001$.

51.5% of the enrolled patients had history of hypertension (HTN). 28 out of 40 patients who had CABSI had hypertension. 60 were those who had hypertension but they did not develop CABSI. On statistical analysis a significant association was seen between HTN and CABSI (p=0.007).

52.1% of total patients were found to be anemic. Out of these 29 developed CABSI, while 60 did not. A statistically significant association was seen between anemia and CABSI.

Similarly, statistical significance was also seen between low albumin levels and occurrence of CABSI. A total of 71 patients were hypoalbuminic. Out of these 24 developed CABSI while 47 did not. Statistical analysis showed a p value of 0.007 and odds ratio of 2.7.

Most common symptom was fever (49.7%). 28 out of 40 patients who developed CABSI had fever as primary complaint, while 57 patients who did not have CABSI developed fever. A p-value of 0.003 showed statistical significance.

Local signs of infection were also evaluated. Our data showed that local site tenderness was most common (42.7%) sign present. But, no statistical significance was seen with development of CABSI (p=0.978).

Local site inflammation and pus discharge both were found to be statistically significant, p value 0.007 and 0.003 respectively. 16/40 patients who developed CABSI had local inflammation while 7 of such patients had pus discharge. In 131 patients who did not develop CABSI, 25 patients had local inflammation while 5 had pus discharge.

Overall mortality in this population was 7% (12/171). Out of 40 patients who had CABSI, 9 died (22.5%). Chi-square test showed a significant correlation of CABSI with mortality ($p < 0.001$).

DISCUSSION

This study collected data of 171 patients who underwent hemodialysis by Non-Tunneled Hemodialysis Catheters (NTHC). Analysis showed that 23.3% of the studied population developed CABSI. These findings are similar to other studies[5,6]. No statistical significant difference was found in age and gender distribution among patients developing CABSI and those who did not have CABSI. Similar results were found in a study of 169 patients done by Varun et al.[7]. Catheter associated bloodstream infection (CABSI) is responsible for increased morbidity; mortality, more so in end stage renal disease patients[8, 9]. This was corroborated by the findings of the current study. Average days spent in hospital was significantly increased in the patients who developed CABSI (P<0.001). Similarly, mortality also increased significantly in these patients. Out of 40 patients who developed CABSI, 9 died (22.5%).

Hypertension in patients is found to be an independent risk factor to develop CABSI[9]. Similar results were found in our study. 70% of patients who developed CABSI were hypertensive. Diabetes, anemia and hypoalbuminemia were also found to be significantly associated with CABSI.

Majority of CABSI (40%) in our study were because of Coagulase positive *Staphylococcus aureus.* These findings are consistent with several other studies[6,10,11].

Table 1: Risk assessment of CABSI with several comorbidities

	CABSI	Non-CABSI	p-value
Diabetes	27	48	0.001
Hypertension	28	60	0.007
Anemia	29	60	0.001
Hypoalbuminemia	24	47	0.007

In our study, on an average, the HD catheter remained in situ for 25.92 ± 5.32 days. In patients who developed CRBSI; mean days of HD catheterization before developing CRBSI was 25.23 ± 5.14 while, it was 26.14 ± 5.37 days in those patients who did not have CRBSI. No statistical significance was found for duration of HD catheterization prior having CRBSI. Kairaitis et al[10] and Almiralli et al[5]in their respective studies also found that the risk of developing CABSI at any point in time is constant.

CONCLUSION

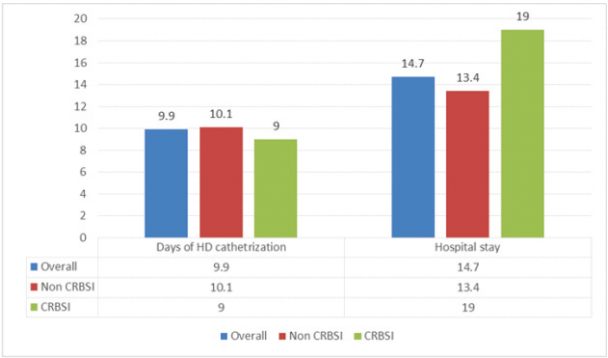

Figure 1: Depiction of effect of CABSI on duration of hospital stay.

Non Tunneled Hemodialysis catheters (NTHC) associated CABSI occur at a high rate with significant morbidity and mortality; especially in diabetics, hypertensive and those with anemia and hypoalbuminemia. Emphasis should be placed on early fistula creation in the course of chronic kidney disease, to avoid use of dialysis catheters. If absolutely required, tunneled catheters to be preferred. If NTHC are used should be placed for minimum required time, with meticulous aseptic and hygiene practices.

REFERENCES

1. Hemachandar R. Practice pattern of haemodialysis among end-stage renal disease patients in Rural South India: A single-centre experience. Saudi J Kidney Dis Transplant 2017; 28: 1150–6.
2. Lakshminarayana GR, Sheetal LG, Mathew A et al. Haemodialysis outcomes and practice patterns in end-stage renal disease: experience from a tertiary care hospital in Kerala. Indian J Nephrol 2017; 27: 51–7.
3. Bello BT, Raji YR, Sanusi I et al. Challenges of providing maintenance haemodialysis in a resource poor country: experience from a single teaching hospital in Lagos, Southwest Nigeria. HemodialInt 17: 427–33.
4. Centres for Disease Control. Bloodstream Infection Event (Central Line-Associated Bloodstream Infection and Non-central Line Associated Bloodstream Infection).
5. Almirall J, Gonzalez J, Rello J, et al. Infection of hemodialysis catheters: incidence and mechanisms. Am J Nephrol.1989;9:454-9.
6. Altaee KH, Theeb OA, Al-Timimi SM, Saeed HM, Alshamma I. Outcome and survival of temporary hemodialysis catheters: A prospective study from a single center in Iraq. Saudi J Kidney Dis Transpl. 2007;18:370-7.
7. R. Katneni, S.S. Hedayati. Central venous catheter related bacteremia in chronic hemodialysis patients: epidemiology and evidence based management. NatClinPractNephrol; 3 (5) (2007): 256-66.
8. A. Varun, V.T. Anna, M. Anjali, et al. Fast and furious: a retrospective study of catheter associated bloodstream infections with internal jugular nontunneledhemodialysis catheters at a tropical centre. Clinical Kidney Journal. 2019;12 (5): 737–44.
9. S.I. Blot, P. Depuydt, L. Annemans, D. Benoit, E. Hoste, J.J. De Waele, *et al.*Clinical and economic outcomes in critically ill patients with nosocomial catheter-related bloodstream infections. Clin Infect Dis. 2005;41:1591-8.
10. S.B. Mishra, R. Misra, A. Azim, A.K. Baronia, K.N. Prasad, T.N. Dhole, M. Gurjar, R.K. Singh, B. Poddar, Incidence, risk factors and associated mortality of central line-associated bloodstream infections at an intensive care unit in northern India, *International Journal for Quality in Health Care*. 2017;29(1):63-7.
11. Kairaitis LK, Gottlieb T. Outcome and complications of temporary haemodialysis catheters. Nephrol Dial Transplant. 1999;14:1710-4.