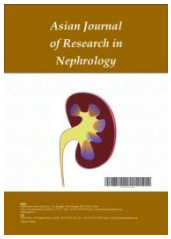

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Thrombotic and Infective Complications in 3 Temporary Non-Tunneled Central Venous Hemodialysis Catheters

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Central venous catheter is a widely accepted form of permanent vascular access which is evolved as a bridge to optimal management in hemodialysis patients. Despite great advances, catheter-related thrombosis and catheter-related bloodstream infection cause catheter

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loss. To mitigate this situation, role of catheter lock solutions has been introduced. As Sodium Bicarbonate is easily available, low cost and associated with less hemorrhagic manifestations.

Aim of the study: This study aimed to assess the use of sodium-bi-carbonate as catheter lock solution in preventing hemodialysis catheter loss.

Methods: This Longitudinal study was conducted at the department of Nephrology in Dhaka Medical College and Hospital for a period of January 2019 to June 2020 following ethical approval. A total of 228 patients finally entered in the study following selection criteria. Study participants were divided into three groups according to the nature of catheter lock solutions, group A Sodium-bi-carbonate, group B Normal saline and Group C Heparin diluted with normal saline. Each group included 76 patients. All patients were subjected detail history taking and relevant investigations. A central venous catheter was inserted all the needful. Intraluminal SBCLS, NSCLS and HCLS lock solution were used in three groups accordingly. All the patients were followed up at 1st week, 2nd week and 3rd week and all information was recorded in separate case record form. After checking all the data was analyzed by SPSS 23.0.

Results: Mean age of the study participants was 54.34 (±8.79). Female respondents were slightly predominant with a percentage of 53.1% and 46.9% male. Socio demographic features were statistically similar in all groups. Catheter related thrombosis was noted at 1.35% in the SBCLS group, 13.69% in the NSCLS group and 8.1% in HCLS group. CRT was lower in the SBCLS group than other two groups with statistical significance ($p<.05$). Catheter related blood stream infection was observed at 1.35%, 8.21% and 16.21% of patients in the SBCLS, NSCLS and HCLS groups accordingly. In the SBCLS group CRBSI was significantly fewer than other groups ($p<.05$). Causes of a catheter loss due to malfunction 4.05% in the SBCLS group, 4.1% in NSCLS group and 5.41% in the HCLS group.

Conclusion: Data concluded that, standard $NaHCO_3$ solution for locking catheter demonstrated significantly less CRT and CRBSI in comparison to normal saline and heparin diluted normal saline. A further clinical trial with a large study Population is recommended.

Keywords: Group; Catheter; Study; Sodium-bi-carbonate (SBCLS); Patients; Normal saline (NSCLS); Heparin diluted with normal saline (HCLS).

1. INTRODUCTION

Chronic kidney disease (CKD) is an essential cause of increasing global morbidity and mortality that constitutes a major public health concern worldwide. Defined as a persistent abnormality in kidney structure or function (eg, glomerular filtration rate-GFR <60 mL/min/1.73m^2 or albuminuria ≥30mg per 24 hours) for more than three months [1]. Global death due to CKD increased significantly over the last three decades that constituting11.38 to 16.05 CKD death per 100,000 population [2]. The data showed that in Bangladesh, 17-18 million of the adult population suffered from CKD stage 1-5; of these, 11-12% were CKD stage 3-5, approximately 150-200 patients per million populations reach ESRD each year, leads to receiving renal replacement therapy for their life [3]. Among the causes of prolonging hospitalization of CKD patients, cardiovascular conditions were the leading single cause, followed by vascular access related reasons especially catheter related blood stream infections and catheter related thrombosis and other forms of systemic infections [4]. Central venous catheters, introduced for short-term hemodialysis in ESRD patients, have become an acceptable form of initial vascular access. Catheter-related complications like thrombosis, intrinsic and extrinsic risk of developing an infection and chance of drug resistance cannot be prevented by conventional lock solution. Thrombotic complications can occur with central venous catheter use with an overall rate of 14-18%. Sometimes it is inevitable to develop catheter-related thrombosis due to some factors, including hypercoagulable states of the blood due to certain co-morbidities like malignancy, sepsis, critical illness, type of catheter used, site and procedure of catheter insertion and maintenance [5]. Both CRBSI and CRT are occasionally lead to catheter loss or replacement thus affecting the overall outcome of the disease by inviting new infection, the chance of thrombotic events, and catheter negotiation-related complications. To prevent those unwanted events, several types of catheter lock solutions are used, among them, Heparin lock solution is widely used to prevent catheter clots as well as catheter-related thrombosis, normal saline is considered as another type of locking solution with no superiority over heparin [6-7]. Other Anticoagulants and Thrombolytic Agents

are being used as locking agents to prevent catheter clots in a few centers worldwide [6]. Besides those, antimicrobial lock solutions has been instilled into the catheter to prevent catheter-related infections as it prevents colonization and bio-film formation within the catheter lumen, but developing antimicrobial resistance is an essential concern of its use [8]. Different studies showed that the conventional catheter lock solutions are selective either as antithrombotic or as an antimicrobial in action. None of them are safe or convenient to use. So, an alternative catheter lock solution of both antithrombotic and antimicrobial properties is required to be sought [9]. Sodium-bi-carbonate catheter lock solution is being highlighted in the studies [10]. As an emerging catheter lock solution to be used in hemodialysis and critical care setting to reduce CRBSI and CRT compared to the conventional one. It demonstrates anti-infective and anti-coagulation properties with a good safety profile, making it an ideal lock solution development target [11]. Pathogens encountering NaHCO3 must devise facultative qualities to survive an environment that interferes with surface adhesion, biofilm formation, and enzymatic processes vital for proliferation. In contrast to the inhibitory effects of $NaHCO_3$, equimolar sodium chloride did not affect growth, ruling out any osmotic or sodium-mediated mechanisms of inhibition [12]. In addition to these antimicrobial properties, an advantage of using SBCLS over other antimicrobial agents is its safety, availability, and low cost that is comparable to normal saline catheter lock solution. The low cost and numerous benefits make SBCLS an ideal candidate for development as a locking solution [10]. In this regard, very few studies had been carried out worldwide of using SBCLS, which was found to be safe and was statistically superior to normal saline in preventing HD catheter loss due to CRT and CRBSI. SBCLS solution is inexpensive, readily available in various settings and holds the potential to decrease hospitalization, length of stay and dialysis-related costs. Thus, the current study might be an initiative to find out the role of sodium bi-carbonate as a single agent to reduce catheter-related thrombosis and catheter-related bloodstream infection in a single tertiary care center in Bangladesh.

2. OBJECTIVES

2.1 General Objective

To determine the comparative outcome of sodium-bi-carbonate over heparin and normal saline based catheter lock solutions in hemodialysis patients with temporary venous access.

2.2 Specific Objectives

- To determine the effect of Sodium-bi-carbonate, Normal saline and Heparin based catheter lock solution for thrombosis in all groups
- To determine the effect of Sodium-bi-carbonate$_3$, Normal saline and Heparin based catheter lock solution for bloodstream infection in all groups.
- Measurement of hemoglobin, S.calcium, S.phosphate, S.albumin, PT, APTT and calculation of INR in different groups.
- To explore the association of different lock solution with thrombosis, blood-stream infection and laboratory parameters in the study population.

3. METHODOLOGY AND MATERIALS

This longitudinal comparative study was executed in the Department of Nephrology, Dhaka Medical College and Hospital, Dhaka from January 2019 to June 2020. A total of 228 ESRD patients Aged>18 years of both sex who were getting Hemodialysis through CVC. Patients with hemorrhagic manifestations, platelet count less than 50x109/l, abnormal PT, abnormal INR, with pre-existing deep vein thrombosis anywhere in the body, patients who are receiving thrombolytic agents had been excluded from the study. Before starting the study, formal ethical approval was taken from the ethical review committee of DMC. For the convenience of the study, study participants were divided into three groups. Group: A Sodium-bi-carbonate, Group B Normal saline and Group C Heparin diluted with normal saline. From each participant informed written consent was taken. History taking focusing clinical features, disease duration along physical examination was done as per standard protocol. All patients were subjected to routine hematological (Hb %), biochemical, and coagulation profiles was done for all patients. Acute dual lumen non tunnelled Central venous catheter made of polyurethane was inserted for hemodialysis by an expert operator under strict asepsis. After each HD treatment, the catheter exit site dressing was changed. Wearing masks and non-sterile gloves catheter manipulation was performed by a trained dialysis staff. Dry gauze dressing used at the catheter exit site was implemented. Hemodialysis was performed only

on Nipro NCU-18 model dialysis machines using Freseniouspolysulfone hem flow F6HPS dialyzer with unfractionated heparin continuous protocol. Catheter blood was rinsed back thoroughly with normal saline solution, after hemodialysis treatment. Then Catheter was flushed and locked with 10 ml in each port with either 7.5% sodium-bi-carbonate in the SBCLS group, sterile 0.9% sodium chloride in the NSCLS group and heparin in normal saline at a concentration of 1000U/ml in the HCLS group. Before connecting the HD catheter to a dialysis machine prior to any treatment, intraluminal SBCLS, NSCLS and HCLS lock solution was removed. During each treatment, patients were monitored daily for complications and standard care was provided to every patient. All the patients were followed up again 1st week, 2nd week and 3rd week. All clinical parameters, baseline investigations, total catheter days, number of HD treatment and cause of catheter loss were recorded in each follow up during the study period. All collected information was stored in separate data record form. Data analysis was carried out by using SPSS version 23.0. Exploratory data analysis was carried out to describe the study population where categorical variables were summarized using frequency tables while continuous variables were summarized using measures of central tendency and dispersion such as mean, median, percentiles and standard deviation. As frequencies and proportions, qualitative or categorical variables were described. Repeated measure ANOVA was used to compare the outcome between three groups. A level of $P< 0.05$ was considered statistically significant.

3. RESULTS

The mean age of the study participants was 54.34±8.90 years. Among them, 81 (35.50%) were in 50-59 years age group and 74 (32.5%) were in ≥ 60 years age group consists most of the patient. Both the mean age and age distribution of the patients in different age groups were statistically similar among the groups (P=0.146 and 0.914 respectively). Among the study cases 121 (53.1%) were female and 107 (46.90%) were male. Gender distribution of the patients was also matched among the groups (p=0.884).

Table 1. Socio-demographic distribution of the patients (N=228)

	SBCLS (n=76) (%)	NSCLS (n=76)(%)	HCLS (n=76)(%)	Overall (n=228)(%)	p-Value
Age					
<40 yrs.	5 (6.58)	4 (5.3)	5 (6.58)	14 (6.1)	0.914
40-49 yrs.	23 (30.26)	17 (22.4)	19 (25.0)	59 (25.9)	
50-59 yrs.	25 (32.9)	27 (35.5)	29 (38.16)	81 (35.5)	
≥60 yrs.	23 (30.26)	28 (36.8)	23 (30.26)	74 (32.5)	
Mean age (Years)	53.12±9.82	55.89±8.57	54.01±8.10	54.34±8.90	0.146
Gender					
Male	37 (48.7)	34 (44.7)	36 (47.4)	107 (46.9)	0.884
Female	39 (51.3)	42 (55.3)	40 (52.6)	121 (53.1)	

Table 2. Different baseline laboratorial findings (Hb, calcium, phosphate, Albumin, PT, APTT and INR) among the patients (n=228)

Laboratory parameter	SBCLS (n=76) Mean ±SD	NSCLS (n=76) Mean ±SD	HCLS (n=76) Mean ±SD	Overall (n=228) Mean ±SD	p-Value
Hemoglobin (gm/dl)	9.11±1.04	9.04±0.92	9.05±1.04	9.07±0.99	0.885
Calcium (mg/dl)	8.57±0.57	8.55±0.57	8.50±0.60	8.54±0.58	0.708
Phosphate (mg/dl)	3.93±1.01	3.91±0.98	3.86±1.00	3.90±0.99	0.99
Albumin (gm/dl)	3.44±0.56	3.49±0.53	3.43±0.56	3.45±0.55	0.756
PT (second)	12.41±2.10	12.37±2.06	12.11±2.00	12.29±2.05	0.615
APTT (second)	28.79±1.98	28.74±1.80	28.70±1.71	28.74±1.82	0.950
INR	1.07±0.04	1.07±0.04	1.06±0.03	1.07±0.03	0.716

Table 3. Distribution of co-morbidities among the patients (n=228)

Co-morbidities	SBCLS (n=76) (%)	NSCLS (n=76) (%)	HCLS (n=76)(%)	Overall (n=228)(%)	p- Value
DM	43 (56.60)	45 (59.20)	47 (61.80)	135 (59.20)	0.804
HTN	66 (86.80)	70 (92.10)	70 (92.10)	206 (90.40)	0.447
CAD	16 (21.10)	15 (19.70)	3 (17.10) 3.90	44 (19.30)	0.821

The mean baseline Hb, Calcium, Phosphate, Albumin, PT, APTT, and INR level of the study participants were 9.07±0.99 gm/dl, 8.54±0.58 mg/dl, 3.90±0.99 mg/dl, 3.45±0.55 gm/dl, 12.29±2.05 second, 28.74±1.82 second and 1.07±0.03 respectively. Mean Hb, calcium, phosphate, albumin, PT, APTT and INR level of the study participants were statistically similar across the groups (p=0.885, 0.708, 0.99, 0.756, 0.615, 0.950 and 0.716 respectively).

Distribution of different co-morbidities like DM, HTN, and CAD were also matched statistically across the groups (p=0.804, 0.447 and 0.821 respectively). Among the study participants 59.20% had DM, 90.40% had HTN and 19.30% had history of CAD.

Among the participants jugular catheterization were performed in 66.23% and femoral catheterization were performed 33.77%.

The mean Hb, Calcium, Phosphate, Albumin, PT, APTT, and INR level of the study participants at follow up (first week) were 10.31±1.90 gm/dl, 8.88±0.62 mg/dl, 3.67±0.81 mg/dl, 3.67±0.81 gm/dl, 12.10±1.96 second, 28.79±1.81 second and 1.07±0.04 respectively. Mean Hb, calcium, phosphate, albumin, PT, APTT and INR level of the study participants were statistically similar across the groups (p=0.406, 0.798, 0.115, 0.352, 0.207, 0.904 and 0.174 respectively).

The mean Hb, Calcium, Phosphate, Albumin, PT, APTT, and INR level of the study participants at follow up (second week) were 10.15±1.88 gm/dl, 8.84±0.60 mg/dl, 3.75±0.87 mg/dl, 3.52±0.49 gm/dl, 12.09±2.07 second, 28.74±1.83 second and 1.07±0.04 respectively. Mean Hb, calcium, phosphate, albumin, PT, APTT and INR level of the study participants were statistically similar across the groups (p=0.886, 0.329, 0.262, 0.744, 0.207, 0.331 and 0.320 respectively).

The mean Hb, Calcium, Phosphate, Albumin, PT, APTT, and INR level of the study participants at follow up (third week) were 10.96±2.03 gm/dl, 8.75±1.29 mg/dl, 3.71±0.95 mg/dl, 3.62±0.41 gm/dl, 11.89±1.67 second, 28.80±1.78 second and 1.07±0.04 respectively. Mean Hb, calcium, phosphate, albumin, PT, APTT and INR level of the study participants were statistically similar across the groups (p=0.479, 0.137, 0.511, 0.185, 0.330, 0.927 and 0.388 respectively).

Table 4. Vein used for catheterization (n= 228)

Catheterization site	SBCLS (n=76) (%)	NSCLS (n=76) (%)	HCLS (n=76) (%)	Overall (n=228)(%)	p- Value
Jugular	49 (64.47)	52 (68.42)	50 (65.79)	151 (66.23)	0.872
Femoral	27 (35.53)	24 (31.58)	26 (34.21)	77 (33.77)	

Table 5. Different laboratorial findings (Hb, calcium, phosphate, albumin, PT, APTT and INR) among the patients at first weeks (n=221)

Laboratory parameter	SBCLS (n=74) Mean ±SD	NSCLS (n=73) Mean ±SD	HCLS (n=74) Mean ±SD	Overall (n=221) Mean ±SD	p- Value
Hemoglobin (gm/dl)	10.20±1.67	10.56±2.39	10.18±1.59	10.31±1.90	0.406
Calcium (mg/dl)	8.89±0.63	8.84±0.65	8.91±0.60	8.88±0.62	0.798
Phosphate (mg/dl)	3.72±0.70	3.52±0.82	3.78±0.88	3.67±0.81	0.115
Albumin (gm/dl)	3.60±0.45	3.54±0.47	3.49±0.48	3.54±0.47	0.352
PT (second)	12.16±1.74	12.35±2.33	11.78±1.74	12.10±1.96	0.207
APTT (second)	28.80±1.66	28.85±1.82	28.72±1.96	28.79±1.81	0.904
INR	1.07±0.03	1.06±0.04	1.08±0.04	1.07±0.04	0.174

Table 6. Different laboratorial findings (Hb, calcium, phosphate, albumin, PT, APTT and INR) among the patients at second weeks (n=185)

Laboratory parameter	SBCLS (n=70) Mean ±SD	NSCLS (n=62) Mean ±SD	HCLS (n=53) Mean ±SD	Overall (n=185) Mean ±SD	p- Value
Hemoglobin (gm/dl)	10.17±1.65	10.23±2.05	10.06±1.99	10.15±1.88	0.886
Calcium (mg/dl)	8.85±0.56	8.92±0.64	8.75±0.60	8.84±0.60	0.329
Phosphate (mg/dl)	3.83±0.93	3.78±0.86	3.58±0.79	3.75±0.87	0.262
Albumin (gm/dl)	3.49±0.49	3.55±0.49	3.54±0.49	3.52±0.49	0.744
PT (second)	11.86±2.29	12.26±1.89	12.2±1.97	12.09±2.07	0.493
APTT (second)	28.93±1.71	28.94±1.69	28.44±1.89	28.74±1.83	0.331
INR	1.07±0.03	1.08±0.04	1.06±0.04	1.07±0.04	0.320

Table 7. Different laboratorial findings (Hb, calcium, phosphate, albumin, PT, APTT and INR) among the patients at third weeks (n=112)

Laboratory parameter	SBCLS (n=44) Mean ±SD	NSCLS (n=34) Mean ±SD	HCLS (n=34) Mean ±SD	Overall (n=112) Mean ±SD	p- Value
Hemoglobin (gm/dl)	11.23±1.85	10.69±1.89	10.88±1.89	10.96±2.03	0.479
Calcium (mg/dl)	8.95±0.63	8.85±1.60	8.39±1.53	8.75±1.29	0.137
Phosphate (mg/dl)	3.81±0.10	3.58±0.79	3.71±1.03	3.71±0.95	0.551
Albumin (gm/dl)	3.62±0.44	3.71±0.32	3.53±0.44	3.62±0.41	0.185
PT (second)	11.64±1.57	11.91±1.67	12.21±1.82	11.89±1.67	0.330
APTT (second)	28.89±1.73	28.77±1.65	28.74±2.03	28.80±1.78	0.927
INR	1.06±0.04	1.08±0.03	1.07±0.04	1.07±0.04	0.388

Table 8. Incidence of catheter loss among the groups (n=221)

Group	Catheter loss		Incidence rate /1000CD	p- Value
	Yes n (%)	No n (%)		
SBCLS	05 (6.76)	69 (93.24)	3.74	0.001
NSCLS	19 (26.02)	54 (73.98)	15.31	
HCLS	22 (29.73)	52 (70.27)	18.23	
Overall	46 (20.81)	175 (79.19)	12.15	

Table 9. Causes of catheter loss in different groups (n=221)

Cause of catheter loss	SBCLS (n=74)	NSCLS (n=73)	HCLS (n=74)	Overall (n=221)
CRT	1 (1.35)	10 (13.69)	06 (08.10)	17 (07.69)
Incidence /1000 CD	0.75	8.06	4.97	4.49
CRBSI	1 (1.35)	06 (8.21)	12 (16.21)	19 (08.60)
Incidence /1000 CD	0.75	4.83	9.94	5.02
Malfunction	03 (04.05)	03 (04.10)	04 (05.41)	10 (04.52)
Incidence /1000 CD	2.24	2.41	3.31	2.64

The incidence of catheter loss was statistically significantly lower in SBCLS group than other two groups (p=0.001). The incidence of catheter loss in SBCLS group, NSCLS group and HCLS group was 6.76%, 26.02% and 29.73% which are correspond to 3.74/1000 catheter days, 15.31/1000 catheter days and 18.23/1000 catheter days respectively. The mean duration of catheter loss was 11.83±2.97 days.

In SBCLS group CRT, CRBSI and malfunctioning catheter were observed among 1.35%, 1.35% and 4.05% cases respectively. In NSCLS group CRT, CRBSI and malfunctioning catheter were observed among13.69%, 08.21% and 4.10%

cases respectively. In HCLS group CRT, CRBSI and malfunctioning catheter were observed among 08.10%, 16.21% and 05.41% cases respectively.

Catheter related thrombosis was also statistically significantly lower in SBCLS group than other two groups (p=0.019). In SBCLS group catheter related thrombosis was observed among 01.35% cases, in NSCLS group catheter related thrombosis was observed among 13.70% cases and in HCLS group catheter related thrombosis was observed among 08.10% cases.

Among 221 study participants malfunctioning catheter was observed among 10 (4.5%) participants. Incidence of malfunctioning catheter was statistically similar across the groups (p=0.905).

Catheter related blood stream infection was also statistically significantly lower in SBCLS group than other two groups (p=0.005). In SBCLS group catheter related blood stream infection was observed among 01.35% cases, in NSCLS group catheter related blood stream infection was observed among 8.20% cases and in HCLS group catheter related blood stream infection was observed among 14.90% cases.

Blood culture report shows that about 32.75% patients had blood stream infection. About 63.15% had infection due to *Staphylococcus aureus*, 15.78% had *E coli*, 15.78% had pseudomonas, and 5.26% had actinobactor.

Table 10. Incidence of catheter related thrombosis in relation to different catheter lock solutions (n=221)

Complication	SBCLS		NSCLS		HCLS		Overall		p-Value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
Catheter related thrombosis	01 (01.35)	73 (98.65)	10 (13.7)	63 (86.3)	06 (8.10)	68 (91.90)	17 (7.70)	204 (92.3)	0.019

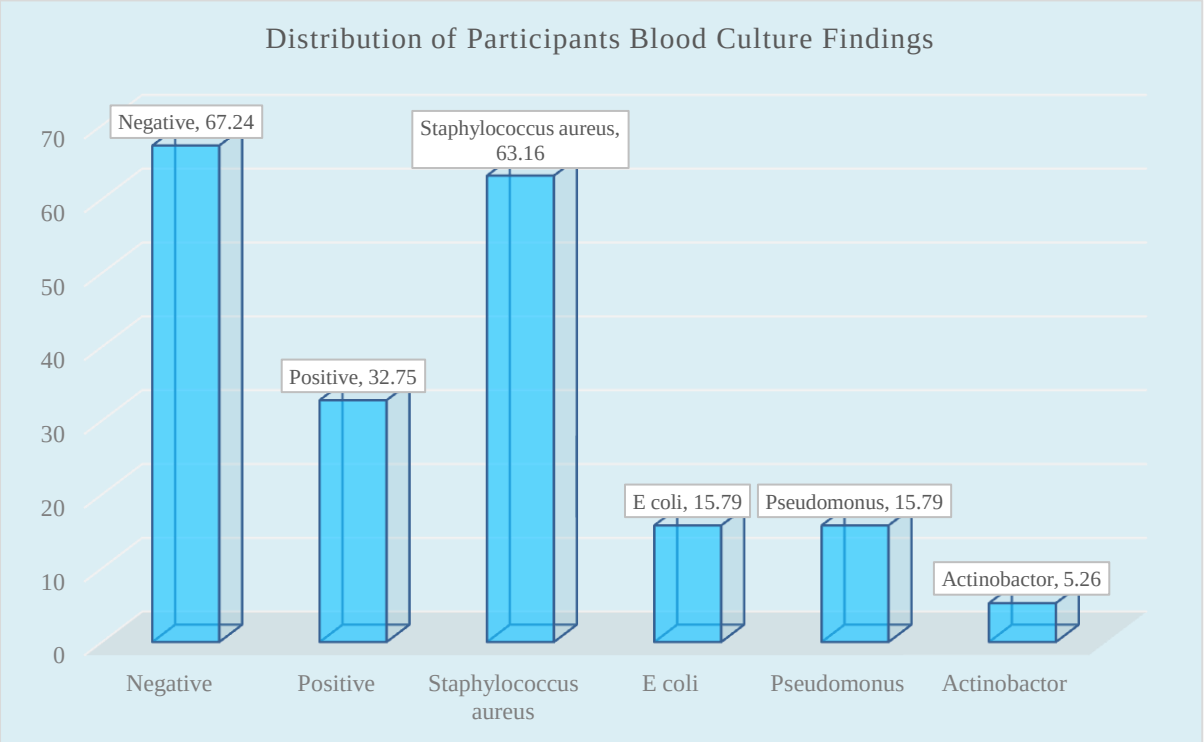

Fig. 1. Participant's blood culture finding

Table 11. Incidence of malfunctioning catheter in relation to different catheter lock solutions (n=221)

Complication	SBCLS		NSCLS		HCLS		Overall		p- Value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
Malfunctioning	03 (4.05)	71 (95.95)	03 (4.10)	70 (95.90)	4 (5.40)	70 (94.6)	10 (04.50)	211 (95.50)	0.905

Table 12. Incidence of catheter related blood stream infection in relation to different catheter lock solutions (n=221)

Complication	SBCLS		NSCLS		HCLS		Overall		p-Value
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
Catheter related blood stream infection	01 (1.35)	73 (98.65)	6 (8.2)	67 (91.8)	11 (14.9)	63 (85.1)	18 (8.15)	203 (91.85)	0.005

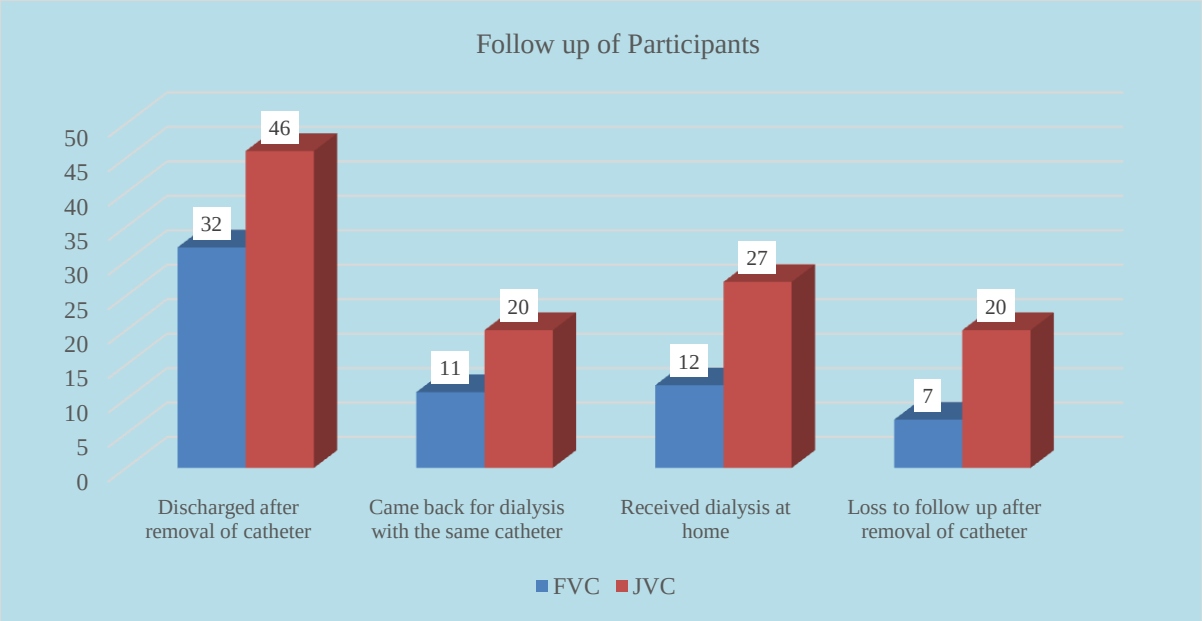

Fig. 2. Participant's follow up details

4. DISCUSSION

This study was aimed to determine the comparative superiority of sodium-bi-carbonate over heparin and normal saline based catheter lock solution in dialysis patients attending tertiary care hospitals. Total 228 patients with CKD getting hemodialysis were included in this study and categorized into three groups (76 patients in each gr according to the catheter lock solution. Group A received Sodium-bi-carbonate, group B received Normal saline and group C received Heparin diluted with normal saline. In this study mean age of the CKD patient was in six decade without any significant difference among the groups (p=0.146). In a study also found the mean age of their study cases in six decade (58.80±12.30 years and 54.90±10.50 years respectively); [13] however, mean age of their study cases in the late fifth decade (49.50±12.70 years). [14] Slight female predominance was observed with 01:01. [13] male-female ratio without any statistically significant difference among the groups (p=0.884). The study conducted by It is also observed slight female predominance among their CKD patients; [15-17] however in a study it had been observed slight male predominance among their CKD patients [18-19]. Monthly family income of the patients was statistically matched among the groups (p=0.631). In a study found 42% of the lower socioeconomic group, 38% in middle

socioeconomic group and 20% in higher socioeconomic group and which is nearly consistent to the finding of this study. Among the study participants different co-morbidities like DM, HTN, and CAD were present in 59.20%, 90.40% and 19.30% cases respectively. The distribution of different co-morbidities was also matched across the groups (p=0.804, 0.447 and 0.821 respectively). History of DM among their 65.45% study cases which was consistent with the finding of this study [20]. HTN and DM among their 90.80% and 36.70% cases respectively; [18] DM among their 41.80% CKD cases; [13] and CAD among their 18.30% Bangladeshi CKD patients respectively [16]. The mean baseline Hb (9.07±0.99 gm/dl), Calcium (8.54±0.58 mg/dl), Phosphate (3.90±0.99 mg/dl), Albumin (3.45±0.55 gm/dl), PT (12.29±2.05 second), APTT (28.74±1.82 second), and INR (1.07±0.03) level of the study participants were statistically matched across the groups (p=0.885, 0.708, 0.99, 0.756, 0.615, 0.950 and 0.716 respectively). The mean Hb, PT, serum Albumin of the study participants were 8.40±1.70 gm/dl, 12.40±2.40 sec, 3.50±0.60 gm/dl which were nearly consistent to the finding of this study [21]. It was also found mean PT, APTT and INR of the study subjects were 12.91±3.19 sec, 33.67±3.99 sec and 1.04±0.30 sec which were also consistent to the finding of this study [22]. In my study the overall catheter loss was observed in 46 (20.81%) cases among different groups and the rate was 12.15/1000 catheter days. The incidence of catheter was loss 6.76% in the SBCLS group, 26.02% in the NSCLS group and 29.76% in the HCLS group. The rate of catheter loss was 3.74, 15.31, and 18.23 per 1000 catheter days in SBCLS, NSCLS, and HCLS groups respectively. In SBCLS group malfunctioning catheters (2.24/1000 CD) was the commonest cause of catheter loss followed by CRT (0.75/1000 CD) and CRBSI (0.75/1000 CD). It also observed in the study, malfunctioning catheter (0.87/1000 CD) as the commonest cause of catheter loss followed by CRT (0.17/1000 CD) and CRBSI (0.17/1000 CD) among SBCLS received patients [23]. In NSCLS group CRT (8.06/1000 CD) was the commonest cause of catheter loss followed by CRBSI (4.83/1000 CD) and malfunction (2.41/1000 CD). CRT (4.1/1000 CD) as the commonest cause of catheter loss followed by CRBSI (2.6/1000 CD) and malfunction (0.86/1000 CD) among NSCLS received cases [23]. In HCLS group CRBSI (9.94/1000 CD) was the commonest cause of catheter loss followed by CRT (8.10/1000 CD) and malfunction (3.31/1000 CD). CRT among their 2% study cases (1.89/1000 CD) who received Heparin as a catheter lock solution but they did not observed any catheter related blood stream infection; however they observed local catheter related infection among 19% of their study subjects (5.03/1000 CD).In terms of catheter loss, statistically significant better outcome was observed in SBCLS group than other two groups (p=0.001) [24]. Although the incidence of malfunctioning catheter was statistically similar across the groups but the incidence of CRT and CRBSI were statistically significantly lower in the SBCLS group than NSCLS and HCLS groups (p= 0.905, 0.019 and 0.005 respectively. A study it observed statistically significant better outcomes in the SBCLS group than NSCLC group [23]. A metanalysis conducted reported almost similar response between the NSCLS and the HCLS in reducing CRT, CRBSI and other malfunctions which are consistent with the finding of this study. Indirect inhibition of the conversion of fibrinogen to fibrin by bicarbonate-mediated chelation of calcium ions may be the possible reason for this lower CRT in the SBCLS group [25]. While the anti-bacterial properties of sodium bicarbonate may be the possible reason for this lowered CRBSI in the SBCLS group than the other two groups. These may be the possible reasons for this overall superiority of sodium bicarbonate over normal saline and heparin diluted with normal saline solutions as a catheter lock solution.

5. LIMITATIONS OF THE STUDY

All samples were collected from a single center. The sample size was not representative to generalize the findings of the outcome of temporary venous access.

6. CONCLUSION AND RECOMMENDATIONS

This study found that using a standard NaHCO3 solution for locking catheters reduced catheter-related thrombosis and catheter related blood stream infection significantly in comparison to normal saline and heparin diluted normal saline. Further trial with a larger sample size is recommended. Sodium Bi Carbonate should be considered as a catheter lock solution to prevent CRT and CRBSI.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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