Nepalese Medical Journal, (2021) Vol. 4, 403 - 409

Original article

Vascular Access Use Among Hemodialysis Patients and Competency of Nurses at National Kidney Centre, Nepal

Nabin Bahadur Basnet[1,2], Jeena Shrestha[1], Sangita Raj Ghatani[1], Sita Thapa[1], Srijana Bhandari[1], Shreejana Karki[1], Subhadra Regmi[1], Rishi Kumar Kafle[1,2]

[1]*National Kidney Centre, Kathmandu, Nepal*

[2]*Sumeru Hospital, Lalitpur, Nepal*

ABSTRACT

Introduction: Vascular access are a prerequisite for hemodialysis and good care by nurses is key to their longevity. A pattern of vascular access use has not been assessed previously nor the competency of nurses to identify the gaps in knowledge and skills. This study aims to describe vascular access use and nursing competency at National Kidney Centre.

Materials and Methods: A cross-sectional study was done to obtain demographic information and history of vascular access of patients. Vascular access was examined. Demographic and professional information of nurses were collected. A quiz based on KDOQI Clinical Practice Guidelines and a visual analogue scale to indicate confidence in managing vascular access were administered to the nurses.

Results: Four-hundred seventy-two patients and 70 nurses were recruited. The proportion of patients with an arteriovenous fistula, arteriovenous graft, tunneled catheter, and non-tunneled catheter at the time of initiation of hemodialysis were 24.36%, 0.64%, 1.27%, and 73.73%, respectively, and after conversion was 67.23%, 5.08%, 1.98%, and 19.77%, respectively. The cost at initiation was lower for catheters and the arteriovenous access in long run. Nurses had received vascular access training during their hemodialysis course (95.71%), but a few received further training (38.57%). They did well in sections related to preparation for permanent access and treatment of complications.

Conclusions: Most of the patients initiated hemodialysis via a non-tunneled catheter. The prevalence of arteriovenous fistula was high. Continued training of nurses was lacking. Nurses were confident in managing arteriovenous fistula and non-tunneled catheters.

Keywords: Arteriovenous fistula; Central venous catheter; Nurse; Renal dialysis

Correspondence:

Dr. Nabin Bahadur Basnet, MBBS, PhD, FISN
Department of Nephrology,
National Kidney Centre
ORCID ID: 0000-0002-3382-8176
Email: dr.nabinbasnet@gmail.com

Submitted: 24th November 2020
Accepted: 20th February 2021

Source of Support: None
Conflict of Interest: No

Citation: Basnet NB, Shrestha J, Ghatani SR, Thapa S, Bhandari S, Karki S, Regmi S, Kafle RK. Vascular access use among hemodialysis patients and competency of nurses at National Kidney Centre, Nepal. NMJ 2021;4(1):403-9. DOI 10.3126/nmj.v3i2.34111

INTRODUCTION

End-stage kidney disease (ESKD) patients are treated with renal replacement therapy (RRT), and hemodialysis (HD) is one of the popular modalities.[1] These patients are dependent on regular HD for survival. Vascular access (VA) is a prerequisite for HD and is considered the Achilles tendon.[2] The choice of VA for a patient depends on various factors and is decided by agreement between the patient's choice and the VA team's expertise.[2] Absence or a malfunction of VA is associated with an inability to deliver good HD and leads to increased morbidity and mortality among HD patients. These VA are prone to various complications, and their longevity may be determined by the care the VA receives which in turn can be dependent on the knowledge and skills of HD nurses.

HD nurses play a key role in the regular assessment and maintenance of VA health. The HD nurses receive extensive training on care and complications associated with VA. Care of VA is one of the mandatory skills among HD nurses. However, there hasn't been any previous study to describe the practice related to VA in HD patients of Nepal and assess the competency of HD nurses in VA management to know where the areas of a deficit are so that further educational programs can be designed to fill the gap. The objective of this study is to appraise the current practice of VA among HD patients and assess the competency of HD nurses in VA care at National Kidney Centre, Nepal.

MATERIALS AND METHODS

A cross-sectional study was done in both HD units of the National Kidney Centre (NKC) in Kathmandu valley in December 2019. The study consisted of interviews of patients undergoing HD, examinations of VA, and questionnaire surveys of HD nurses responsible for the management of VA. Approval was obtained from the institution and verbal consent was taken from all the participating HD patients and nurses. All the patients undergoing HD and HD nurses of the centre who consented to participate were included.

Patients were interviewed to obtain their demographic profile, history of illness, and history of VA. History of VA consisted of a type of VA at the time of initiation and subsequent VA, problems with VA encountered, preference of VA, and cost of VA creation. VA of each patient was examined by standard method[3,4] and findings noted. For the purpose of locating the lesions, "inflow segment" was defined as the segment containing feeding artery, anastomosis, and juxta-anastomotic area (> 4 cm from anastomosis), "body of AFV" was considered to be cannulation segment up to 10 cm downstream from the juxta-anastomotic area, and "outflow segment" considered as segment downstream from the body of AFV to a central vein.[4] The cost of VA was calculated according to the cost being offered at the centre. Patients were grouped into two groups according to the VA at the time of initiation of HD for comparison – AFV/AVG Group and Central Vein Catheter (CVC) Group. The AFV/AVG group had patients who initiated HD via AFV or AVG, and the CVC group had patients who initiated HD via CVC – both TCC and non-TCC.

Similarly, the HD nurses attending the patients were given questionnaires with 3 parts – demography and professional history, multiple-choice quiz on different aspects of VA management, and visual analogue scale (VAS) to indicate how confident the nurses felt managing different types of VA. The test questions were based on KDOQI Clinical Practice Guidelines for Vascular Access, Update 2006[5] under the following sections – I. patient preparation for permanent HD access, II. selection and placement of HD access, III. cannulation of AVF/AVG and accession of CVC, IV. detection of access dysfunction: monitoring, surveillance, and diagnostic testing, and V. treatment of AVF, AVG, and CVC complications. Four multiple-choice questions with one most appropriate answer were made for each section. A score of 1 was given for each correct choice and 0 for incorrect. There was one VAS to indicate a level of confidence in managing AVF, AVG, non-TCC, and TCC each with 0 sets as not at all confident to 10 as extremely confident.

The collected data were tabulated and subjected to statistical analysis in LibreOffice Calc 6.1.1.2 (The Document Foundation, Berlin, Deutschland). The results were expressed as means and standard error (mean±SE). Student's t-tests were used to analyse continuous variables and a Chi-square test was used to analyse categorical variables. The statistical significance was set at $p \leq 0.05$.

RESULTS

Patients and VA

The study enrolled 472 patients from 2 units of NKC. Most of the patients were male (65.25%), and the average age was 48.67 ± 0.74 years. These patients had ESKD and were on HD for an average of 5.14 ± 0.18 years and 1.34 ± 0.13 years, respectively. Out of the total patients, 16.10% of the patients had initiated HD within a year. The demographic characteristics of the patients are given in Table 1.

Table 1: Characteristics of patients among the study population

Characteristics		n=472
Sex	**Male**	308 (65.25%)
	Female	164 (34.75%)
Age (years)		48.67 ± 0.74 (range 15 – 85)
Literacy	**Illiterate**	31.78%
	Informal education	6.99%
	High School	55.3%
	University	5.93%
Family income (NPR/month)	**< 20,000**	9.11%
	20,000 – 40,000	65.89%
	40,000 – 60,000	15.25%
	>60,000	9.75%
	CKD Since (years)	5.14 ± 0.18 (0 – 25 years)
HD Vintage	Average (years)	1.34 ± 0.13 (0 – 18 years)
	< 1 year	16.10%
	1 – 5 years	51.69%
	5 – 10 years	29.45%
	10 – 15 years	2.97%
	>15 years	0.64%

The VA at the time of initiation were – AVF, AVG, or CVC. CVC was either TCC or non-TCC – subclavian vein catheter (SC), internal jugular vein catheter (IJ), or femoral vein catheter (FC) (fig. 1). Most of the patients had initiated HD via CVC (75%). The proportion was the same in male and female patients. The chance of having AVF/AVG or not was found to be significantly affected by the monthly income of the family (p=0.024) and duration of CKD (p<0.01) but not by the literacy of the patients (Table 2). This choice was also affected significantly by whether the patient had received counseling for VA before the initiation of HD (Table 2, p<0.01). Among the various VA at the time of initiation of HD, the majority of the patients had SC (36.65%) or IJ (22.88%). AVF was the first VA for 24.36% of the patients. The majority of the patients had initiated HD unplanned and for urgent indications (fig. 2). The analysis of the cost of VA born by patients showed that the average initial cost of VA was higher for AVF/AVG group than for the CVC group (NPR 11440.68 ± 812.06 vs NPR 6556.50 ± 323.66, p<0.01). The patients had different problems with their VA and for various reasons had to convert to another VA. Those of the CVC group converted to AVF (67.23%), AVG (5.08%), TCC(1.98%), or other non-TCC(19.77%) as the second VA. The average cost of access as estimated as cost per patient per year in HD was lower among patients of AVF/AVG group than CVC group (NPR 5921.60 ± 651.50/patient/year vs NPR 8724.8 ± 445.95/patient/year, p<0.01) (fig. 3).

Table 2: Comparison between patients who initiated hemodialysis with the AVF or AVG and patients who initiated with CVC.

		AVF/AVG Group (n=118)	CVC Group (n=354)	p value
Age (years)		55.03 ± 1.53	46.55 ± 0.83	< 0.001
Sex	**Male**	25.00%	75.00%	1
	Female	25.00%	75.00%	
Literacy	**Literate**	24.53%	75.47%	0.73
	Illiterate	26.00%	74.00%	
Family Income	**<20,000**	13.95%	86.05%	0.024
	20,000 – 40,000	23.15%	76.85%	
	40,000 – 60,000	30.56%	69.44%	
	>60,000	39.13%	60.87%	
CKD duration (years)		1.90 ± 0.31	1.12 ± 0.15	<0.01
Counselling for Vascular Access	**Received**	84.74%	43.78%	<0.01
	Not received	15.25%	56.21%	

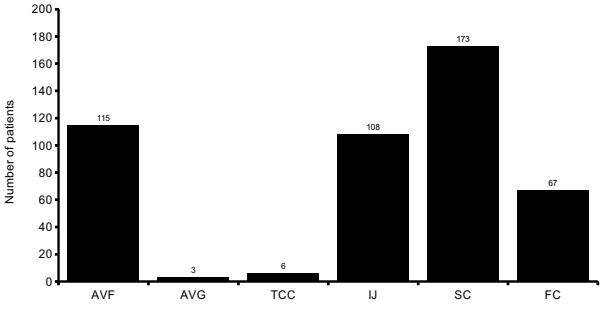

Figure 1: Different vascular access types at the time of initiation of hemodialysis at National Kidney Centre (n = 472).

Permanent access – AVF (24.36%) and AVG (0.64%) - formed an only quarter of the total vascular accesses. The majority of the patients had central vein hemodialysis vascular accesses –TCC (1.27%), Non- TCC- internal jugular vein (22.88%), non- TCC- subclavian vein (36.65%), and non-TCC- femoral vein (14.19%) (fig. 1).

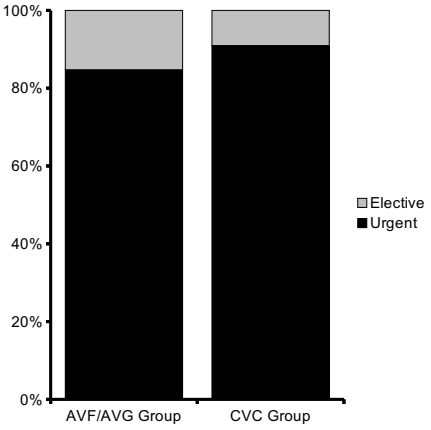

Figure 2: Majority of patients with AVF or AVG (84.75%) and patients with CVC (90.96%) at the time of initiation of hemodialysis initiated hemodialysis for unplanned or urgent indications. (p=0.06)

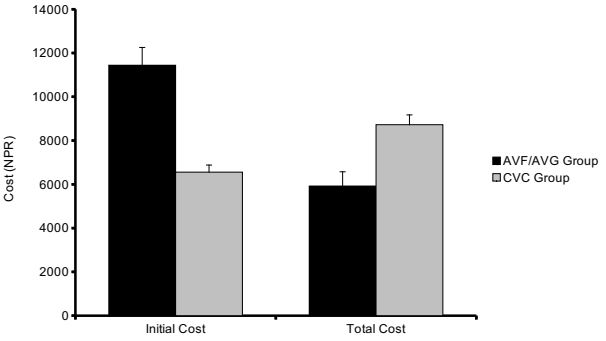

Figure 3: The average cost of vascular access to the patients.

The average cost at the time of initiation of hemodialysis was higher for patients with AVF or AVG than those with CVC for dialysis (NPR 11440.68 ± 812.06 vs NPR 6556.50 ± 323.66, p<0.01). The average cost during the period the patients are in maintenance hemodialysis as calculated as NPR/patient/year was lower in a patient who initiated hemodialysis with AVF/AVG than those with CVC (NPR 5921.60 ± 651.50 /patient/year vs 8724.80 ± 445.95 /patient /year, p<0.01)(fig. 3)

One quarter of the patients of both groups experienced different complications of VA (fig. 4). Patients of both the group complained of pain due to VA. Those with AVF/AVG experienced significantly higher problems related to the functioning of the VA – non-function (6.8%), difficult cannulation (1.7%), and flow problem (2.5%) – than those with CVC. Those with CVC complained mainly of discomfort due to the VA. The patients were asked which VA would they prefer. Almost all the patients of both groups said they would prefer AVF (95.76% and 94.63%) over other VA types (fig. 5). All the patients enrolled underwent a clinical examination of VA. AVF was the most prevalent VA (90.47%) at the time of examination (fig. 6).

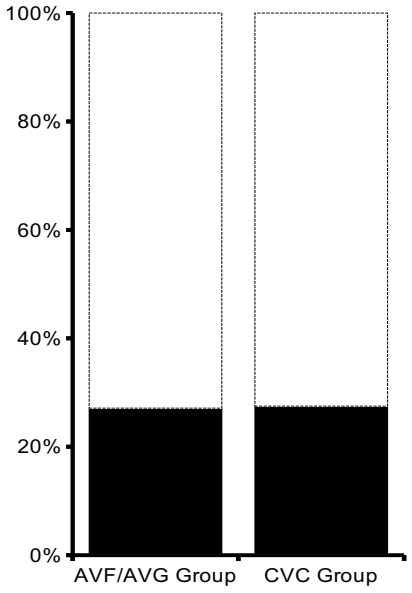

Figure 4A

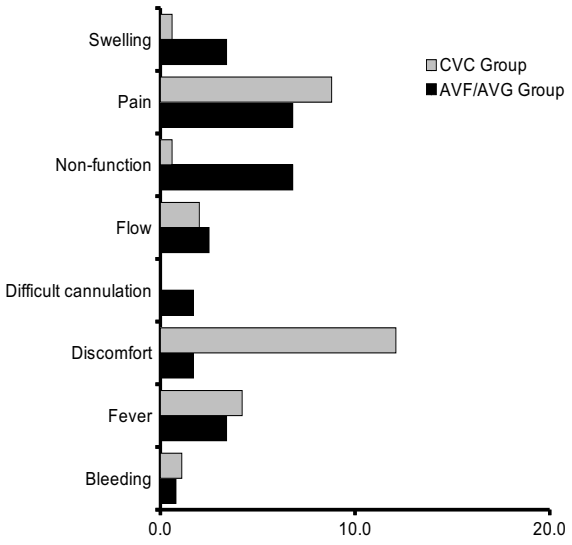

Figure 4B

Figure 4: Complications were seen with the initial vascular access for hemodialysis. **(4A).** Both the group of patients – those with AVF or AVG and CVC – experienced a similar incidence of complications (27.12% and 26.55%). The type of complications experienced **(4B)** were different in the two groups. AVF/AVG group had more difficult cannulation (1.7% vs 0%), non-function (6.8% vs 0.60%), and swelling (3.4% vs 0.6%) than CVC group. CVC group had more discomfort (12.1% vs 1.7%) than AVF/AVG group.

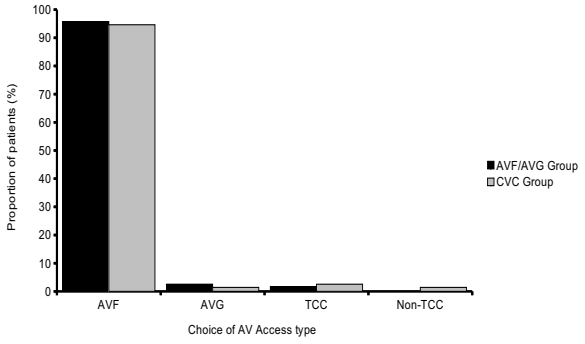

Figure 5: Preference of hemodialysis access type by patients under maintenance hemodialysis at National Kidney Centre (n=472).

The majority of both the patients with AVF or AVG at the time of hemodialysis initiation (95.76%, 94.63%) preferred AVF rather than other types of hemodialysis vascular access – AVG, TCC, and non-TCC.

The majority of the patients were doing their dialysis with AVF (90.47%). Other vascular accesses were – AVG (0.42%), TCC (2.54%), internal jugular vein catheter (IJC, 2.75%), subclavian vein catheter (SCC, 3.18%), and femoral vein catheter (FVC, 0.64%)(fig.6)

AVF was found to be healthy without any significant clinical finding in the majority of the patients. The most common problem (fig. 7 A) seen with AVF was aneurysmal dilatation (35.6%). Other findings were mostly signs of flow obstruction in AVF – inflow obstruction (3.98%), obstruction at the body of AVF (3.51%), outflow obstruction (5.39%), and co-existing obstruction (4.45%). Similarly, CVC was examined for its hygiene and health(fig. 7 B). One TCC was found to have serious discharge from the tunnel, and 11.63% of the CVC did not have a proper dressing over the CVC. There were no other significant observations.

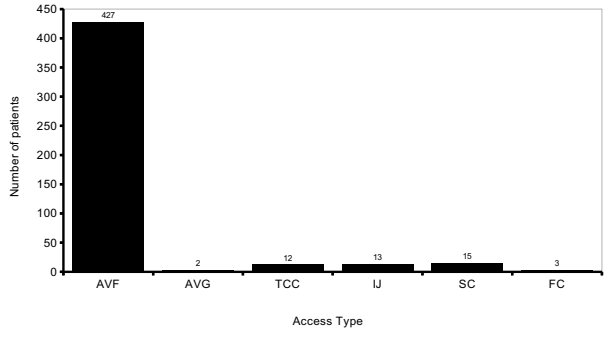

Figure 6. Prevalence of different hemodialysis vascular accesses.

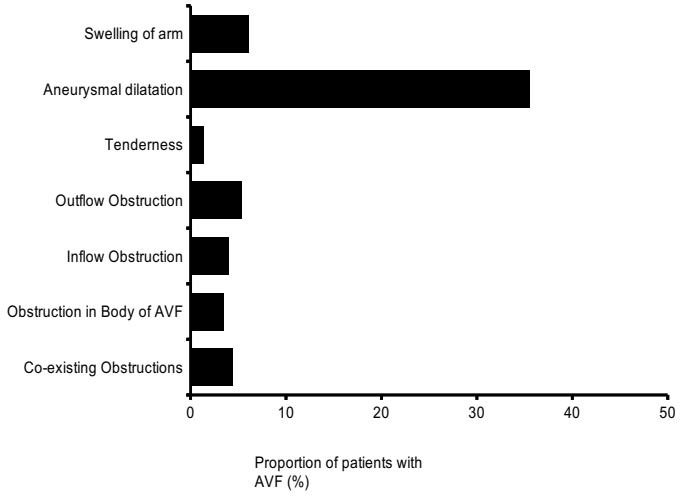

Figure 7A

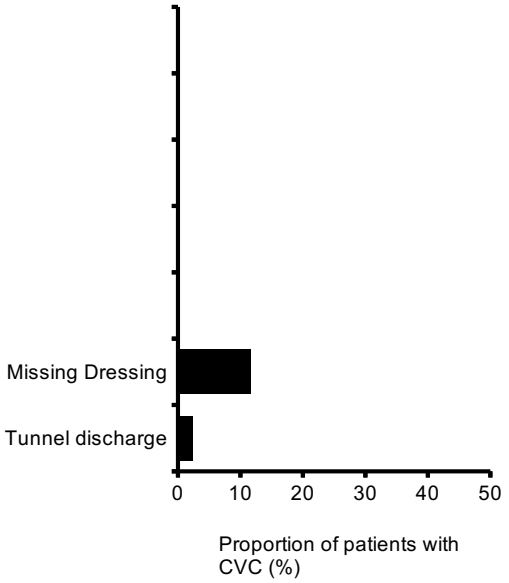

Figure 7B

Figure 7: Examination finding of vascular accesses. **7A**. Examination of AVF showed aneurysmal dilatation of AVF (35.6%) was the most common finding. Other findings were swelling of the arm (6.09%), tenderness (1.41%), and features of outflow obstruction (5.39%), inflow obstruction(3.98%), at the body of AVF(3.51%), and co-existing obstructions(4.45%). **7B.** CVC showed missing dressing(11.63%) and tunnel discharge(2.33%).

Hemodialysis Nurses

Out of 75 HD nurses employed at Kathmandu and Lalitpur units of NKC, 70 HD nurses consented and participated in the study. All the HD nurses were female and had received 3 months of basic and 6 months of advanced HD training at the beginning of their posting in the HD centres. Most of the nurses had completed Proficiency Certificate Level in Nursing (51.43%) and worked in HD centre for 1 to 5 years (68.57%) (Table 3). These nurses had received training on VA during their HD nursing course (95.71%). Only 38.57% had attended further workshops or training on VA management after joining the centre as HD nurses. When they were asked whom would they approach when there is any problem managing VA, most of the HD nurses identified senior nurses (57.14%) and books (30%) as their source of help (fig. 8).

Table 3: Characteristics of hemodialysis nurses

Characteristics		N=70 (%)
Age (years)	**15-25**	55.71%
	25-35	40%
	35-45	4.29%
Sex	**Male**	0%
	Female	100%
Education	**Auxiliary Nurse midwife**	1.40%
	Proficiency Certificate Level in Nursing	51.43%
	Post Basic Bachelor in Nursing	32.86%
	Masters in Nursing	14.29%
Experience as hemodialysis nurse (years)	**< 1**	4.29%
	1 – 5	68.57%
	5 – 10	18.57%
	10 – 15	4.29%
	15 – 20	4.29%

The HD nurses were given a multiple-choice quiz with 5 sections. The average scores for sections I, II, III, IV, and V were 2.96, 2.33, 2.25, 2.77, and 2.94 out of 4, respectively. The majority of nurses did well and scored 4 in sections I and V (42.86% and 38.57%) and scored 3 in Sections II and IV (44.29% and 54.29%). Most of the nurses did fair and scored 2 or 3 out of 4 in Section III (40% and 31.43%) (fig. 9). From the VAS that estimated the level of confidence of nurses in managing VA, the highest level of confidence was seen in managing non-TCC scoring on average 8.77 ± 0.24 and least level of confidence managing AVG scoring on average 6.21±0.32.

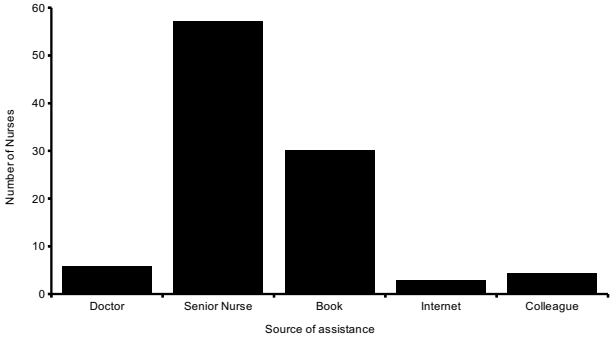

Figure 8: Source of assistance. Most of the hemodialysis would approach their senior nurses (57.14%) or book (30.00%) in case they needed some help in the management of VA.

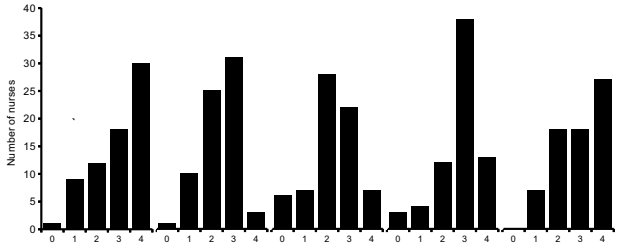

Figure 9: Assessment of hemodialysis nurses. Hemodialysis nurses were given 5 categories of questions – (I) Patient preparation (II) selection and placement of hemodialysis access (III) cannulation of AVF and AVG and accession of hemodialysis catheters (IV) detection of access dysfunction and (V) treatment of AVF and central vein hemodialysis catheter complications. They were scored from 1 to 4. The performance was well in Sections I, II, IV, and V and fair in section III.

In figure 10, we can see that most of the nurses gave themselves a score of 8-9 (57.14%), 6-7 (54.29%), 8-9 (57.14%), and 9-10 (75.71%) for confidence in managing AVF, AVG, TCC, and non-TCC, respectively.

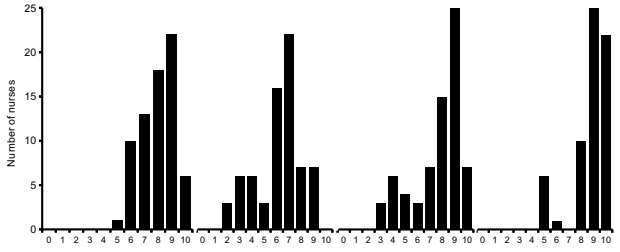

Figure 10: Confidence of nurses in the management of vascular access by type assessed by a visual analogue scale with 0 being least confident and 10 being highest confidence. Nurses showed the highest confidence managing non-TCC with an average score of 8.77±0.24 and least confident managing AVG with an average score of 6.21±0.32 ($p<0.01$). Scores for AVF and TCC were 7.94±0.22 and 7.65±0.33, respectively.

DISCUSSION

A well-functioning VA is a prerequisite for adequate HD[6] but a provision of such access and maintenance is challenging for nephrologists and HD nurses. Despite AVF being desirable for its superiority in lower mortality risk as well as patency rates, there are various situations in which a good AVF may not be achievable and patients initiate or need to continue their HD via other forms of VA.[6].

The incidence and prevalence of AVF in Nepalese HD patients have not been studied though the most common form of RRT in the country is HD.[7] This small study involving just 2 units of NKC represents around 10% of the total HD patients in Nepal shows a very low incidence of AVF (25%) at the time of initiation of HD. This may be due to various factors such as patients seeking nephrology care at a very advanced stage of ESRD which is also evident by the finding that most of the patients initiated HD for urgent indications rather than elective indications (fig. 2). Other causes could be lack of confidence of patients in VA, financial difficulties, and expertise of the doctors doing the procedure. In our population, two factors that were found to be associated with having HD initiated with AVF/AVG were income of the family, duration of CKD, and VA counselling. These factors have not been previously explored.

Among the CVC, the most prevalent type was found to be SC CVC at the time of initiation of HD. SC CVC is undesirable when alternative VA are available[6] but some centres advocate for use of SC CVC as the CVC of choice.[8] A high incidence of SC CVC could also be due to recall errors of the patients as they may not distinguish between SC and IJ. The patients preferred AVF over other forms of VA as long-term VA and most of the patients ultimately converted to AVF over other forms of VA. For this reason, 90.47% of the participating patients had AVF at the time of the study. Conversion from CVC to AVF/AVG decreases the risk of mortality in the long run.[9n] This phenomenon of conversion from one form of VA to another is implicated to late referral to nephrologists and may be associated with higher mortality risks in incident dialysis patients.[10] Those initiating on AVF/AVG also had financial benefits in the long run though the initial costs seemed to be higher in this group which is supported by previous studies comparing the cost-effectiveness of VA selection.[11]

This study indicates a worrying situation where there is a very low incidence of AVF among patients initiating HD and very high use of CVC. The use of CVC and AVG are associated with a higher risk of mortality when compared with AVF.[12,13] This study only includes patients who were available and agreed to participate in the study and could contribute to a biased result. Further study on this aspect with an appropriate sampling of the patient can give a better picture as well as the cause of the practice of VA.

Almost all the HD nurses (95.47%) who participated in the study had received training on VA but the continuity of further training does not seem to be adequate. Management of VA is challenging and the knowledge and skills have to be regularly updated. A quiz designed based on previous guidelines of KDOQI[2] was administered to the nurses as they had been trained before the publication of the latest guidelines.[6] The knowledge of the HD nurses was satisfactory in sections of patient preparation and management of complications and fair in other sections. The nurses were confident managing non-TCC and AVF which they came across more frequently than AVG and TCC which are not prevalent in the HD population of the two centres.

Further training of the nurses should be designed accordingly to ensure that quality care to the patients is delivered. Understandably, the nurses are more proficient in the management of AVF and non-tunnelled CVC as they mostly encounter these VA in daily practice. Workshops with real or simulated VA that the nurses do not get an opportunity to exercise should be designed to improve the knowledge as well as skills of the nurses. The involvement of nurses in VA counselling also reduces the fraction of patients starting HD with CVC.[14]

CONCLUSIONS

HD patients are initiated mostly with non-tunnelled CVC; and they later convert mostly to AVF. The HD nurses receive training on VA but do not get opportunities to update their knowledge and skills on VA. The HD nurses are confident in managing non-tunnelled CVC and AVF which they frequently come across but are not confident in managing AVG and TCC which they encounter very less often.

REFERENCES

1. Kidney Disease: Improving Global, Group Outcomes (KDIGO) CKD Work. KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int 2013;3:1–150. Crossref
2. Besarab A, Ford Hospital H, Work J, Brouwer D, McMurray C, Timothy Bunchman PE, et al. Clinical Practice Guidelines for Vascular Access. Am J Kidney Dis 2006;48:S176–247. Crossref
3. Salman L, Beathard G. Interventional nephrology: Physical examination as a tool for surveillance for the hemodialysis arteriovenous access. Clin J Am Soc Nephrol 2013;8:1220–7. Crossref
4. Asif A, Leon C, Orozco-Vargas LC, Krishnamurthy G, Choi KL, Mercado C, et al. Accuracy of physical examination in the detection of arteriovenous fistula stenosis. Clin J Am Soc Nephrol 2007;2:1191–4. Crossref
5. National Kidney Foundation. KDOQI Clinical Practice Guidelines and Clinical Practice Recommendations for 2006 Updates: Hemodialysis Adequacy, Peritoneal Dialysis Adequacy and Vascular Access. Am J Kidney Dis 2006;48:S1–322. Crossref
6. Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, et al. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis 2020;75:S1–164. Crossref
7. Sahay M, Jasuja S, Tang SCW, Alexander S, Jha V, Vachharajani T, et al. Aetiology, practice patterns and burden of end-stage kidney disease in South Asia and South-East Asia: A questionnaire-based survey. Nephrology 2020:nep.13825. Crossref
8. Shafique MN, Akhtar SH, Mahnoor M, Hussain M. Hemodialysis internal jugular vein versus subclavian vein catheters: Complications, patients' comfort, tolerance and cost-effectiveness. Pakistan J Med Sci 2019;35:124–8. Crossref
9. Allon M, Daugirdas J, Depner TA, Greene T, Ornt D, Schwab SJ. Effect of change in vascular access on patient mortality in hemodialysis patients. Am J Kidney Dis 2006;47:469–77. Crossref
10. Bradbury BD, Chen F, Furniss A, Pisoni RL, Keen M, Mapes D, et al. Conversion of Vascular Access Type Among Incident Hemodialysis Patients: Description and Association With Mortality. Am J Kidney Dis 2009;53:804–14. Crossref
11. Al-Balas A, Lee T, Young CJ, Kepes JA, Barker-Finkel J, Allon M. The clinical and economic effect of vascular access selection in patients initiating hemodialysis with a catheter. J Am Soc Nephrol 2017;28:3679–87. Crossref
12. Dhingra RK, Young EW, Hulbert-Shearon TE, Leavey SF, Port FK. Type of vascular access and mortality in U.S. hemodialysis patients. Kidney Int 2001;60:1443–51. Crossref
13. Polkinghorne KR, Mcdonald SP, Atkins RC, Kerr PG. Vascular Access and All-Cause Mortality: A Propensity Score Analysis. J Am Soc Nephrol 2004;15:477–86. Crossref
14. Polkinghorne KR, Seneviratne M, Kerr PG. Effect of a Vascular Access Nurse Coordinator to Reduce Central Venous Catheter Use in Incident Hemodialysis Patients: A Quality Improvement Report. Am J Kidney Dis 2009;53:99–106. Crossref