Original article

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

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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
INTRODUCTION

End-stage kidney disease (ESKD) patients are treated with renal replacement therapy (RRT), and hemodialysis (HD) is one of the popular modalities. These patients are dependent on regular HD for survival. Vascular access (VA) is a prerequisite for HD and is considered the Achilles tendon. 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. 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 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. 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 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 ≤ 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)** | |
| 1 – 5 years | 29.45% |
| 5 –10 years | 51.69% |
| 10 – 15 years | 2.97% |
| >15 years | 0.64% |
| **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)** | |
| 0 | 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 VA     |                       |                   |         |
| 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 NPR 8724.8 ± 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 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.

Figure 6. Prevalence of different hemodialysis vascular accesses.

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 (IJ, 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 7A

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.
difficulties, and expertise of the doctors doing the procedure. In causes could be lack of confidence of patients in VA, financial urgent indications rather than elective indications (fig. 2). Other evident by the finding that most of the patients initiated HD for nephrology care at a very advanced stage of ESRD which is also a very low incidence of AVF (25%) at the time of initiation of RRT in Nepal shows the country is HD. This small study involving just 2 units of NKC have not been studied though the most common form of RRT in The incidence and prevalence of AVF in Nepalese HD patients represents around 10% of the total HD patients in Nepal shows the finding that most of the patients initiated HD for very high use of CVC. The use of CVC and AVG are associated with a higher risk of mortality when compared with AVF. 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 was administered to the nurses as they had been trained before the publication of the latest guidelines. 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.

**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.
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