

Original Research Article

Vascular access and its complications in patients with chronic kidney disease on haemodialysis: a retrospective analysis

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ABSTRACT

Background: Inadequate vascular access in patients on haemodialysis is a major cause of hospitalization leading to life threatening complications. This study evaluated the types of vascular access, location and associated complications in patients with chronic kidney disease (CKD) on haemodialysis.

Methods: Patients with CKD stage V on haemodialysis were included in the study. The data was retrospectively collected including demographic details, comorbidities, serum creatinine, haemoglobin, type and site of access and associated complications.

Results: A total of 82 patients with mean (SD) age of 56.6(13.9) years were included with 50 (60.9%) patients on arteriovenous fistula (AVF) access and remaining 32 (39.1%) on dual-lumen catheter (DLC). Hypertension (42.6%) was the most common comorbidity reported followed by diabetes (24.3%) and chronic glomerulonephritis (13.4%). In AVF access, 25 (50.0%) had wrist as site of access, 10 (20.0%) had forearm, 11(22.0%) had brachiocephalic and four (8.0%) brachiobasilic. Of 32 DLC access, 27(84.4%) had jugular vein and four (12.5%) femoral vein. One patient with AVF access reported venous hypertension; however, the complications reported in patients with DLC access were infection (n=6, 18.8%) and hematoma and venous hypertension (n=1, 3.7%, each).

Conclusions: This study with limited sample size showed that the most common access site for AVF and DLC was wrist and jugular vein, respectively. Infection was the most common complication in patients with DLC. AVF is comparatively safe option for haemodialysis; however, DLC should be used only as a temporary option.

Keywords: Catheter, Chronic kidney failure, Complications, Dialysis access, End stage renal disease

INTRODUCTION

Chronic kidney disease (CKD) is a major public health burden leading to increased rate of morbidity and mortality. The different causes of kidney dysfunction include poor sanitation, water contamination, nephrotoxins and comorbidities primarily chronic glomerulonephritis, hypertension, and diabetes. In India, the incidence of end-stage renal disease (ESRD) was reported to be approximately 150-200/pmp and 40-60% of the cases of CKD had diabetes and hypertension.^{1,2}

According to data from Indian Society of Nephrology's Registry, in 2010 more than 54% of patients registered had CKD stage V.

Haemodialysis and renal transplantation are the two treatment modalities used for the management of patients with ESRD. For haemodialysis, it is important to have good vascular access to avoid life threatening complications. Around half of the complications in patients undergoing haemodialysis are related to vascular access.³ Native arteriovenous fistula (AVF),

arteriovenous graft (AVG) and central vein catheter (CVC) are different types of vascular access. The most frequently used and preferred access is AVF due to its less complication rate and greater patency with long-term stability. According to National Kidney Foundation guidelines, the order of AVF site for haemodialysis is as follows: forearm (radiocephalic or distal AVF), elbow (brachiocephalic or proximal AVF), arm (brachial or basilic AVF with transposition or proximal AVF).⁴ When central vein access is needed, internal jugular vein is the first approach and femoral vein is the second approach for the insertion of dialysis catheters.⁵ For a patient to undergo maintenance haemodialysis, a functional fistula is important; however, unfortunately in India patients reach nephrologist late where no functional fistula is available, hence haemodialysis is started with temporary catheter where the risk of infection is high.

Previous study has reported the mortality rate after four years follow-up as 27% with AVF, 50% with temporary central venous catheter and 75% with permanent central venous catheter. The infection was the most commonly reported complication.⁶ The paper presents results of a study that evaluated the various types of vascular access in patients with CKD on haemodialysis and the vascular access location, failure rate and associated complications.

METHODS

This was a retrospective observational study conducted between January 2015 and June 2017 at Shalby Hospitals, Ahmedabad, India. The eligibility criteria included: patients of either sex aged more than 18 years; patients with a diagnosis of stage V CKD and undergoing haemodialysis eligible for participation. Patients with CKD stage I to IV, patients with renal transplant or patients undergoing peritoneal dialysis were not eligible for this study.

As this was a retrospective observational study ethics committee approval exempted and written informed consent was also not considered necessary. However, the study was conducted in accordance with International Council for Harmonisation - Good Clinical Practice (ICH-GCP), the ethical principles that have their origin the Declaration of Helsinki and other local requirements.

Data was collected from hospital records which included demographic details (age and sex), comorbidities (diabetes, hypertension, chronic glomerulonephritis, etc.), serum creatinine levels, haemoglobin levels, type and site of AVF access, and associated complications were recorded. The type of AVF access included radiocephalic - wrist, radiocephalic - forearm, brachiocephalic, or brachiobasilic. The type of dual lumen catheterization access included jugular, femoral and subclavian access.

As this was a retrospective analysis of the hospital data or medical records, there was no formal sample size calculation employed for this study. The data was

collected in an excel sheet, analysed and presented using descriptive statistics (number and percentage) and mean and standard deviation where appropriate.

RESULTS

A total of 82 patients were included in the study who had CKD stage V and were started with haemodialysis during January 2015 and June 2017 at our hospital. The mean (standard deviation [SD]) age was 56.6 (13.9) years and the age ranged from 23 to 88 years. A total of 41 (69.5%) patients were aged more than 50 years. The majority of participants were males (n=49, 59.7%); however, 33 patients were females (40.2%). A total of 35 (42.6%) patients had hypertension, 20 (24.3%) had diabetes and 11 (13.4%) patients had chronic glomerulonephritis. The mean (SD) serum creatinine was 8.18 (2.81) mg/dL and ranged from 3.16 mg/dL to 16.93 mg/dL. The mean (SD) haemoglobin was 9.35 (1.78) gm/dL and ranged from 5.9 gm/dL to 12.9 gm/dL (Table 1).

Table 1: Demographics and clinical characteristics.

Parameter	N=82
Age (years), mean (SD)	56.6 (13.9)
Sex, n (%)	
Male	49 (59.7)
Female	33 (40.2)
Comorbidities, n (%)	
Diabetes	20 (24.3)
Hypertension	35 (42.6)
Chronic glomerulonephritis	11 (13.4)
Others	16 (19.5)
Serum creatinine (mg/dL)	8.18 (2.81)
Haemoglobin (gm/dL)	9.35 (1.78)

Data presented as mean (SD), unless otherwise specified.

Table 2: Vascular access on initiation of dialysis.

Parameter	N=82
Arteriovenous fistula	50 (60.9)
Radiocephalic - wrist	25 (50.0)
Radiocephalic - forearm	10 (20.0)
Brachiocephalic	11 (22.0)
Brachiobasilic	4 (8.0)
Dual lumen catheterization	32 (39.1)
Jugular	27 (84.4)
Femoral	4 (12.5)
Subclavian	1 (3.1)

Data presented as n (%).

Among total of 82 patients, 50 (60.9%) of patients had AVF and 32 (39.1%) had DLC. Of the 50 AVFs, 25 (50%) patients had vascular access on wrist (radiocephalic), 10 (20.0%) had access on forearm (radiocephalic), 11 (22.0%) had brachiocephalic access and four (8.0%) patients had brachiobasilic AVF access. Of the 32 DLCs, 27 (84.4%) accesses were on jugular,

four (12.5%) were on femoral and one (3.1%) was on subclavian vein (Table 2).

A total of seven (14%) patients with AVF had limb oedema and three (6%) patients with AVF had primary non-function. A total of nine (10.9%) complications were reported in seven patients (AVF, n=1; DLC, n=6). The complication reported with AVF was venous hypertension. However, in patients treated with DLC, majority of them had infection (n=6, 18.8%), one patient (3.1%) each had hematoma and venous hypertension (Table 3).

Table 3. Summary of complications.

Parameter	N=82
Arteriovenous fistula (n=50)	
Venous hypertension	1 (2)
Dual lumen catheterization (n=32)	
Infection	6 (18.8)
Hematoma	1 (3.1)
Venous hypertension	1 (3.1)

Data presented as n (%).

DISCUSSION

Haemodialysis is most efficient and safe therapy used in patients with ESRD. However, the risk of vascular complication increases with frequent haemodialysis.⁷ To avoid these complications adequate vascular access is needed. Arteriovenous fistula is the preferred access which lasts longer due to less complications and more success rate. The gold standard location for AVF is wrist. Other sites include radio-cephalic forearm, brachiocephalic or brachial-basilic.⁴ However, in patients with diabetes, severe atheromatous and older patients, the AVF is to be constructed on upper arm.⁸

In the present study, the mean age of the patients was 56.6 years, around 70% of patients were aged more than 50 years; and the majority (n=49) of patients were male population. This is consistent with the literature that though, ESRD is reported in all ages, it is more commonly seen in advancing age. Additionally, the increasing prevalence of diabetes and hypertension in elderly contributes to the development of kidney disease. In the present study, 24.3% had diabetes and 42.6% had hypertension, which is comparatively less than previous reports. In a previous study from Egypt by Ghonemy et al., 38.66% had diabetes and 64.71% had hypertension.⁹ Another study from India by Hemachandar, had patients with mean age 51.28 years, 46% had diabetes and 72% had hypertension.¹⁰

Similarly, a study from the United States also showed that 52% of their patients had history of diabetes.¹¹ The difference in our results from previously published studies could be possibly due to smaller sample size and difference in study population.

In the present study, 50 patients had AVFs which was slightly higher than DLC (n=32). Of the 50 AVFs, wrist (50%) was the common site and among DLCs, jugular (84.4%) was commonest. This was slightly lower with previous study by Hemachandar 60% and 98.3%, respectively.¹⁰ This could be due to the difference in study site and smaller sample size. A previous study by Shahidi et al. compared vascular access types from 2003 to 2013 and showed that in 2003 AVFs were used in 60% of patients which was 35% in 2013; similarly, temporary catheter was used in 39% patients in 2003 and was reduced to 20% in 2013. They also reported that around 35% of patients had permanent catheter in 2013, however, none of the patients in 2003 had it.¹² The difference in the present study could be attributed to changing practice and development in the management of these patients.

In another study 271 fistulas with 86 proximal, 180 distal, and five mid forearms were reported. Eighty-one fistulas were constructed on right side and 190 were on left side.¹³ One eighty-seven patients had AVF on radial artery and 84 had AVF on brachial artery.¹³ In general, when AVF is planned, non-dominant limb preferred, for example, if the patient is right-handed, left arm is preferred.

In the present study, 10.9% of patients reported various complications. The complication reported by patients with AVF was venous hypertension and the most common complication in DLC patients was infection. These complications are similar to previous reports.^{6,9-17} The complications reported by Mahakalkar et al. in patients with AVF were oedema, infection, bleeding at operative site, ecchymosis at the operative site.¹⁴ However, Susan et al. reported early complications as thrombus, haematoma, bleeding and wound infection, and late complications as thrombosis, pseudoaneurysm.¹⁵ In another study, majority of patients with AVF had steal phenomenon and distal edema.¹³ Another study reported most common complication in patient with AVF was thrombosis (30.5%).⁶ Another study reported data of 96 patients with 104 femoral catheters used for 1 to 26 days. Infection was the major complication reported with double-lumen femoral vein catheters consistent with our study.¹⁸ The complications of DLC were consistent with the previous reports. The number of complications reported with DLC were higher as compared to those with AVF.

The authors would like to acknowledge few limitations in the study. The present study was a retrospective single-centre study with very smaller sample size. The retrospective findings may have inherent bias. Hence, the findings should be cautiously generalized.

CONCLUSION

Overall, results demonstrated that the most common access for AVF and DLC was wrist and jugular vein, respectively. Infection was the most common complication in patients with DLC. AVF is

comparatively safe option for haemodialysis; however, DLC should be used only as a temporary option.

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Ethical approval: Not required

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