Original Article

Femoral Arteriovenous Grafts for Hemodialysis: Using the Profunda Femoris Artery

Hossam Z. Yousuf, Alaa Eldin Mahmoud, Marwan Youssry, Mohammed Ali

Department of General and Vascular Surgery, Faculty of Medicine, Cairo University, Egypt.

ABSTRACT

Background: Dialysis access techniques have advanced significantly in recent years. Traditionally, arteriovenous (AV) fistulas for dialysis access were created in the upper limb (UL). However, groin access is now being considered for patients with exhausted UL options.

Objective: Evaluation of the efficacy and safety of the profunda femoris artery as an inflow vessel for angioaccess grafts in hemodialysis cases.

Methods: A Quasi-experimental study was conducted on 72 patients diagnosed with chronic renal failure who were no longer candidates for UL AV grafts or fistulas. The study was carried out at a tertiary hospital between October 2023 and February 2025, divided into Group 1 (33 patients) receiving profunda femoris artery grafts and Group 2 (39 patients, control group) using the superficial femoral artery. Cases were followed up at 1, 3, 6, and 12 months post-surgery, assessing graft patency and complications.

Results: The mean age of participants was 56±12 years in Group 1 and 58±9 years in Group 2, with female predominance. Ischemic complications were higher among group 2 cases (P= 0.01). By the end of the first year after surgery, 25 grafts (75.8%) of Group 1 remained patent vs 27 grafts (69.2%) in Group 2. Diabetes mellitus was found in 71.3% of patients with infections (P= 0.01) and in 85.7% of patients with ischemic complications (P= 0.001). Of those suffering ischemic complications, five suffered obesity (71.3%) (P= 0.006).

Conclusion: The profunda femoris artery is an effective and safe inflow vessel for hemodialysis access, offering comparable outcomes to the superficial femoral artery and upper extremity options.

Key Words: Arteriovenous grafts, hemodialysis, patency rate, profunda femoris.

Received: 16 February 2025, **Accepted:** 24 March 2025, **Published:** 1 October 2025

Corresponding Author: Hossam Z. Yousuf, MD, Department of General and Vascular Surgery, Faculty of Medicine, Cairo University, Egypt. **Tel.:** 01004377543, **E-mail:** hossam.yousef@kasralainy.edu.eg

ISSN: 1110-1121, October 2025, Vol. 44, No. 4: 1190-1198, © The Egyptian Journal of Surgery

INTRODUCTION

Over the past 30 years, substantial advancements have been made in dialysis access techniques. As the techniques have progressed, various anatomical sites have been explored for AV access, including bilateral sites at the wrist, brachial area in the forearm and upper arm, axillary sites in the upper arm or chest, and femoral locations in the groin[1]. Traditionally, arteriovenous (AV) fistulas for dialysis access have been created in the upper extremities. In (1966), Brescia and colleagues introduced an internal AV fistula connecting the radial artery to the cephalic vein[2]. Despite initial interest, groin access has received limited focus over the past two decades due to early reports of high infection rates and significant risk of major limb amputation. More recently, groin access has been considered for patients with exhausted upper extremity options due to arterial steal syndrome, recurrent thrombosis, severe axillary or subclavian artery disease, or venous obstruction[4].

The introduction of expanded polytetrafluoroethylene (ePTFE) for subcutaneous hemodialysis grafts, combined with advances in surgical procedures and dialysis care, has renewed interest in the groin as a viable access site. For patients unsuitable for native fistulas, grafts made from ePTFE represent effective alternatives[3]. We, therefore, reviewed our experience with using the profunda femoris artery as an inflow vessel for angioaccess grafts in the groin to evaluate the safety and effectiveness for hemodialysis patients while minimizing the risk of ischemic complications.

PATIENTS AND METHODS

This is a quasi-experimental study that involved 72 cases who attended the Vascular Surgery Department at a tertiary teaching hospital between October 2023 and February 2025. These patients were diagnosed

DOI: 10.21608/EJSUR.2025.361114.1395

with chronic renal failure and were no longer suitable candidates for upper extremity hemodialysis arteriovenous (AV) grafts or fistulas. The study included patients who had exhausted their arm vessels for AV fistulas, lacked adequate vasculature for arteriovenous fistulas (AVF) creation, had a significant arterial disease that posed a risk for steal syndrome or had bilateral central venous occlusions. Patients were excluded if they had ipsilateral peripheral occlusive disease, severe obesity (grade III), a small diameter profunda femoris artery less than 4mm, a length of profunda femoris artery less than 3cm, or those suffering chronically low blood pressure.

Patients undergoing femoral arteriovenous grafts (AVG) were classified into two groups. Group 1 involved 33 cases with the profunda femoris artery as the inflow vessel, while Group 2, the control group, included 39 patients with superficial femoral artery as the inflow vessel.

Sample size:

The sample size was estimated using the PASS 15 software, based on the difference between two proportions, in line with the study's primary objective, which is to compare the rate of ischemic complications between femoral AV grafts for hemodialysis using the superficial femoral artery and the profunda femoris artery. A previous study[5] reported that the incidence of amputation (an ischemic complication) in femoral AVG using the superficial femoral artery was 22%. However, no studies have been conducted on the ischemic complications associated with femoral AVG using the profunda femoris artery. We assumed an incidence rate of 0.5% for ischemic complications in this group.

Using these assumptions (22% vs. 0.5% ischemic complications between the two groups), a sample size of 66 patients (33 in each group) was calculated, incorporating a 10% dropout rate, 80% statistical power, and a 0.05 level of significance.

Ethical consideration:

The institutional Ethical Research Committee examined and approved the study protocol (Code N-411-2023). Patients received a thorough explanation of the procedure, potential complications, benefits, risks, and alternative treatment options, followed by obtaining written informed consent. Participation was completely optional, and the individual could withdraw from the study at any time. All phases of data collection, entry, and analysis were carried out in a private and confidential manner in compliance with the Declaration of Helsinki.

Preoperative Evaluation:

Each patient underwent comprehensive history-taking and clinical assessment, emphasizing risk factors for peripheral occlusive disease and previous fistula surgeries. Cardiological consultation was done for patients with cardiac risk factors to assess fitness for surgery. Routine laboratory tests were conducted, and a detailed duplex ultrasound study was performed to evaluate the arterial and venous systems.

Surgical Technique:

An intravenous dose of 1.0g cefazolin was administered one hour before surgery. The surgical field, including the lower abdomen and thigh down to the ipsilateral knee, was prepared. A 6cm longitudinal skin incision was made below the inguinal ligament along the anteromedial thigh. The profunda femoris artery, just distal to its origin from the common femoral artery, along with the femoral vein and its branches, was exposed. The first branch of the profunda artery was ligated and divided to facilitate better exposure. A lateral longitudinal arteriotomy (1–1.5cm in length) was created in the profunda femoris artery.

A PTFE graft (Jotec® FlowLine Bipore, 6mm) was cut at a 45° angle and positioned at the arteriotomy. The graft was tunneled subcutaneously in an inferior direction, and a distal skin incision was made to ensure no kinks existed in the loop, which averaged 25–30cm in length. The graft was then routed superiorly to reach the exposed femoral vein. A medial longitudinal venotomy (2cm) was made for the veno-graft anastomosis (Figure 1).

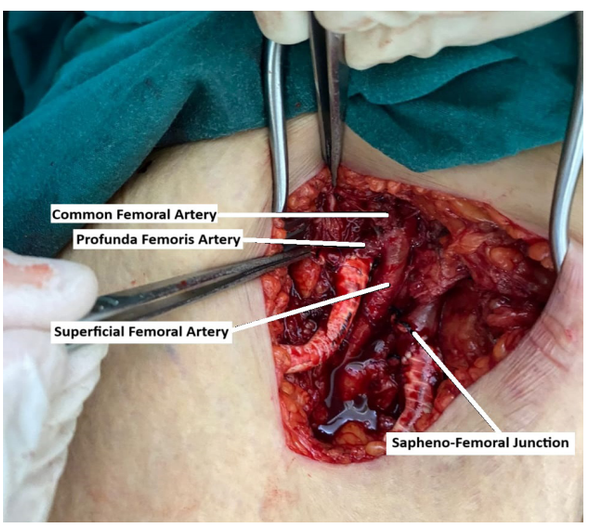

Fig. 1: Looped graft between the profunda femoris artery and the great saphenous vein in the right thigh.

After the arterial and venous clamps were removed, a palpable thrill was expected along the graft. Sutures for the upper incision were removed after 14 days, while those for the lower incision were removed after 21 days. Cannulation was advised 10–14 days postoperatively.

Postoperative Management:

All patients were prescribed dipyridamole (75mg, three times daily) indefinitely. Low-dose aspirin (100mg) was additionally administrated continuously unless contraindicated.

Follow-up:

The cases were followed up at 1, 3, 6, and 12 months post-surgery. They were assessed for complications and patency of the graft. Primary patency was defined as uninterrupted graft function without the need for interventions. Secondary patency refers to the graft's overall lifespan from its insertion to discontinuation or removal.

Graft Surveillance:

Indicators of potential graft failure included unexplained rises in venous pressure or extended bleeding after decannulation, which would prompt further assessment. Routine angiography or ultrasound assessments were not conducted for grafts that were functioning adequately.

Statistical analysis:

To ensure completeness and logical consistency, all of the acquired data was edited. Microsoft Office Excel (2019) was used to input pre-coded data into the computer. The Statistical Package for Social Science (Statistical Package for Social Science) version 26.0 (IBM®, SPSS, USA) was then utilized to transfer and enter the pre-coded data for statistical analysis. The mean and standard deviation (SD) were used to summarize the data for the quantitative parameters. To compare groups, the independent *t*-test was used. Frequency and percentage were used to summarize the data for qualitative parameters. The Chi-square test was used to compare the groups. If the *P*-value was less than 0.05, it was considered significant. Kaplan Meier analysis was done to identify the secondary graft patency.

RESULTS

This study included 72 patients who presented to the vascular surgery department suffering CRF and fulfilling our inclusion criteria. The patients with femoral arteriovenous grafts were classified into two groups: Group 1 involved 33 cases who had the profunda femoris artery as the inflow vessel, while Group 2, the control group, included 39 patients who had the superficial femoral artery as the inflow vessel.

The participants' ages had a mean of 56±12 years and 58±9 years for group 1 and group 2, respectively. Each group was primarily comprised of females, representing slightly more than fifty percent of the total. However, (Table 1) demonstrates that there were no statistically substantial variations in the two groups' medical backgrounds or demographic information.

Perioperative complications:

Different perioperative complications were encountered, as shown in (Table 2). Nine of the study cohort suffered wound infections, 3(9.1%) of which were in Group 1 and 6(15.4%) were in Group 2; however, this variation between the two groups showed no statistically substantial difference (*P*= 0.421). *E. coli* and Klebsiella mainly caused the infections. These infections were localized without associated bacteremia. Among the nine patients, a notable majority of 7 individuals (90.8%) had a degree of obesity (4 with class 1 obesity and 3 with class 2 obesity). This observation was detected to be statistically substantial (*P*<0.001). All infections resolved completely with local care and appropriate systemic antibiotics. It is worth noting that an association between ischemic complications and wound infections was found where three patients suffered from both conditions (*P*= 0.011).

Additionally, wound seroma developed in 11 patients, 5(15.2%) in Group 1 and 6(15.4%) in Group 2, all of whom responded to conservative management. It is significant to point out that 9(81.8%) of those who suffered seroma were classified as obese (8 with class 1 obesity and 1 with class 2 obesity), which was considered a statistically substantial association (*P*<0.001).

Likewise, limb edema, likely due to transient venous stasis, was observed in 11 patients, 5(15.2%) in Group 1 and 6(15.4%) in Group 2, and resolved spontaneously within 2–6 weeks. Among these, eight patients were obese between grades I and II, which was also a statistically significant finding (*P*<0.001).

Four patients, two in each group, had lymphoceles; three of these cases were treated conservatively with local compression and percutaneous aspiration to drain the fluid under ultrasound guidance, followed by at least one weekly follow-up to repeat the treatment; one patient in Group 1 needed open surgery with internal marsupialization.

Late graft infections and bacteremia were documented in seven cases, with three individuals (9.1%) affected in Group 1 and four individuals (10.3%) in Group 2 without a statistically significant difference (*P*= 0.868). All cases involved Gram-negative bacterial cultures. The graft was removed in every instance, with above-knee amputations required in three patients from Group 2. Out of these seven patients, five were diagnosed with diabetes (71.3%) (*P*<0.01). Three patients fell into the categories of class I and II obesity (42.8%) but were not statistically significant (*P*= 0.06).

Additionally, Graft thrombosis occurred in 12 patients, with 6(18.2%) cases in Group 1 and 6(15.4%) in Group 2 without a substantial variation between the two study groups.

Graft patency:

Regarding the follow-up of graft patency, in Group 1, thrombosis was observed in 3 grafts at 3 months, 2 grafts at 6 months, and 1 graft at 12 months. Thrombectomy was successfully performed in 5 patients, with balloon angioplasty at the venous side required in 2 cases. Hypotension was identified as a predisposing factor in these cases, while the single failed case was attributed to

a hypercoagulable state caused by pelvic malignancy. In Group 2, thrombosis occurred in 3 grafts at 3 months and three grafts at 6 months. Thrombectomy was successful in 5 patients, with 1 requiring balloon angioplasty at the venous side. Hypotension was a contributing factor in these cases, and the failed case resulted from graft ligation due to ischemic complications. We observed that 8 out of the 12 patients presented with diabetes, a finding that reaches statistical significance ($P< 0.01$) (Table 3).

Ischemic complications:

Ischemic complications occurred in 7 cases, all of which were in Group 2(17.9%). Among these, 3 cases resulted from superficial femoral artery (SFA) ligation following infection and graft removal, ultimately requiring above-knee amputation. The remaining 4 cases developed severe incapacitating claudication that was unresponsive to medical treatment, necessitating graft ligation by the end of the first year. Analyzing the difference in ischemic complications between the two groups, the results revealed a statistically significant greater ischemic rate among the control participants ($P<0.01$). It is worth noting that among the seven affected patients, six were diabetic, five were obese, and 3 had a history of cerebrovascular stroke. The analysis of the affected patients reveals significant associations between specific health conditions and the outcomes observed, highlighting the potential interplay between these comorbidities and ischemia. Among the seven patients identified, six exhibited diabetes mellitus, five were classified as obese, and three had a documented history of cerebrovascular stroke, with these findings being statistically substantial ($P= 0.001$, $P= 0.006$, and $P= 0.05$, respectively) (Table 4).

Graft survival:

Kaplan-Meier analysis was performed to evaluate cumulative transplant survival (Figure 2). In Group 1, 25 grafts (75.8%) remained patent at the end of the first year. Of the eight grafts lost during this period, three were due to patient deaths: one from cardiovascular causes, one from a cerebrovascular event, and one from pneumonia. At the time of their deaths, all of these individuals had functional grafts. Likewise, at the end of the first year, 27 grafts (69.2%) in Group 2 were patent. Four of the twelve grafts lost during the year were as a result of patient deaths: two from pneumonia and two from cardiovascular reasons. Notably, at the time of their deaths, every patient who passed away during the research period had functional femoral grafts.

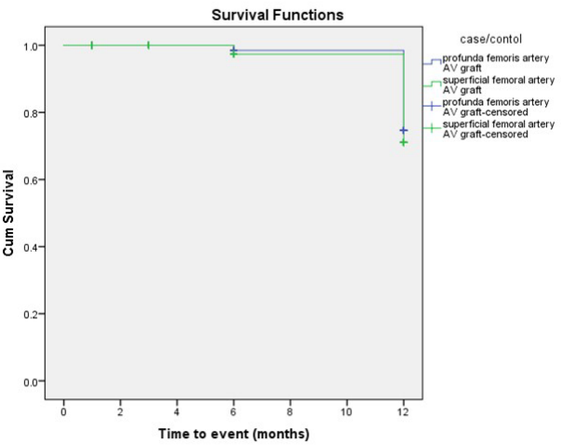

Fig. 2: Cumulative graft survival among study participants.

Table 1: relation between sociodemographic, medical history of patients and the type of AV graft:

Variable		Profunda femoris artery AV graft (*n*=33)	Superficial femoral artery AV graft (*n*=39)	*P* value
Age (years) mean±SD		56±12	58±9	0.518
Sex, *n*(%)	Male	12(41.4%)	17(58.6%)	0.533
	Female	21(48.8%)	22(51.2%)	
DM, *n*(%)	Negative	24(47.1%)	27(52.9%)	0.745
	Positive	9(42.9%)	12(57.1%)	
HTN, *n*(%)	Negative	23(43.4%)	30(56.6%)	0.488
	Positive	10(52.6%)	9(47.4%)	
Coronary artery disease, *n*(%)	Negative	30(46.9%)	34(53.1%)	0.616
	Positive	3(37.5%)	5(62.5%)	
Obesity, *n*(%)	No obesity	25(46.3%)	29(53.7%)	0.964
	Grade I	6(46.2%)	7(53.8%)	
	Grade II	2(40.0%)	3(60.0%)	
Smoking, *n*(%)	Negative	28(48.3%)	30(51.7%)	0.397
	Positive	5(35.7%)	9(64.3%)	
Cerebrovascular disease, *n*(%)	Negative	28(46.7%)	32(53.3%)	0.751
	Positive	5(41.7%)	7(58.3%)	
DVT, *n*(%)	Negative	30(47.6%)	33(52.4%)	0.421
	Positive	3(33.3%)	6(66.7%)	

DM: Diabetes Mellitus; DVT: Deep Venous Thrombosis; HTN: Hypertension; SD: Standard deviation.

Table 2: Relation between complications due to AV graft and Type of AV graft:

Complication, *n*(%)		Profunda femoris artery AV graft (*n*=33)	Superficial femoral artery AV graft (*n*=39)	*P*-value
Central venous occlusion	Negative	8(24.2%)	9(23.1%)	0.783
	BL	11(33.3%)	16(41.0%)	
	UL	14(42.4%)	14(35.9%)	
Early* wound infection	Negative	30(90.9%)	33(84.6%)	0.421
	Positive	3(9.1%)	6(15.4%)	
Early* wound seroma	Negative	28(84.8%)	33(84.6%)	0.978
	Positive	5(15.2%)	6(15.4%)	
Limb oedema	Negative	28(84.8%)	33(84.6%)	0.978
	Positive	5(15.2%)	6(15.4%)	
Early* lymphocele	Negative	31(93.9%)	37(94.9%)	0.863
	Positive	2(6.1%)	2(5.1%)	
Late** graft infection	Negative	30(90.9%)	34(87.2%)	0.868
	Positive	3(9.1%)	4(10.3%)	
Late** graft thrombosis	Negative	27(81.8%)	31(79.5%)	0.751
	Positive	6(18.2%)	6(15.4%)	
Procedure-related mortality	Negative	33(100.0%)	39(100.0%)	___
	Positive	0(0.0%)	0(0.0%)	
Ischemic complications	Negative	33(100.0%)	32(82.1%)	0.01
	Positive	0(0.0%)	7(17.9%)	

*: Within the first-month post-intervention; **: After one-month post-intervention; BL: Bilateral; UL: Unilateral.

Table 3: Follow-up of graft patency among both study groups:

Variables *n*(%)		Profunda femoris artery AV graft (*n*=33)	Superficial femoral artery AV graft (*n*=39)	*P*-value
1st-month graft patency	Patent	33(100.0%)	39(100.0%)	___
3rd-month graft patency	Patent	30(90.9%)	36(92.3%)	0.56
	Thrombectomy	2(6.1%)	2(5.1%)	
	Thrombectomy patent	1(3.0%)	1(2.6%)	
6th-month graft patency	Patent	30(90.9%)	33(84.6%)	0.757
	Thrombectomy	2(6.1%)	3(7.7%)	
	Infection removal	1(3.0%)	2(5.1%)	
	Infection controlled	0(0.0%)	1(2.6%)	
	Died not related	3(9.1%)	4(10.3%)	
12th-month graft patency	Patent	25(75.8%)	28(71.8%)	0.993
	Infection	2(6.1%)	2(5.1%)	
	Occluded	1(3.0%)	1(2.6%)	
	Removal	1(3.0%)	2(5.1%)	
	Thrombectomy but failed	1(3.0%)	2(5.1%)	

Table 4: Ischemic complications and other risk factors:

		Ischemic complications				*P*-value
		Negative		Positive		
		Count	Row *N*%	Count	Row *N*%	
DM	Negative	50	98.0%	1	2.0%	0.001
	Positive	15	71.4%	6	28.6%	
HTN	Negative	48	90.6%	5	9.4%	0.89
	Positive	17	89.5%	2	10.5%	
Cardiac CAD	Negative	58	90.6%	6	9.4%	0.778
	Positive	7	87.5%	1	12.5%	

		Ischemic complications				*P*-value
		Negative		Positive		
		Count	Row *N*%	Count	Row *N*%	
Obesity class I /II	No obesity	52	96.3%	2	3.7%	0.006
	Grade I obesity	10	76.9%	3	23.1%	
	Grade II obesity	3	60.0%	2	40.0%	
Smoking	Negative	52	89.7%	6	10.3%	0.717
	Positive	13	92.9%	1	7.1%	
Cerebrovascular disease	Negative	56	93.3%	4	6.7%	0.05
	Positive	9	75.0%	3	25.0%	
DVT	Negative	61	96.8%	2	3.2%	<0.001
	Positive	4	44.4%	5	55.6%	
No of previous accesses	0	2	100.0%	0	0.0%	0.482
	2	9	75.0%	3	25.0%	
	3	24	92.3%	2	7.7%	
	4	21	95.5%	1	4.5%	
	5	7	87.5%	1	12.5%	
	6	2	100.0%	0	0.0%	
Central venous occlusion -VE/ UL /BL	negative	15	88.2%	2	11.8%	0.838
	BL	24	88.9%	3	11.1%	
	UL	26	92.9%	2	7.1%	

BL: Bilateral; CAD: Coronary Artery Disease; DM: Diabetes Mellitus; DVT: Deep Venous Thrombosis; HTN: Hypertension; UL: Unilateral.

DISCUSSION

Hemodialysis relies on the creation, maintenance, and preservation of reliable vascular access. With the increasing longevity of patients undergoing hemodialysis, along with the growing prevalence of elderly and diabetic patients requiring chronic dialysis, complications associated with vascular access have significantly risen. Up to 20% of hospitalizations in hemodialysis cases are attributed to vascular access malfunctions[6].

Arteriovenous fistulas (AVFs) in the upper extremities are the recommended method of vascular access for long-term hemodialysis, according to current clinical practice guidelines. When AVF creation is not feasible, arteriovenous grafts (AVGs) in the arm are favored over central venous catheters (CVCs) due to lower rates of infection and improved patient survival[7-10].

Grafts also aid in preventing central venous stenosis and other issues related to the use of CVCs[11]. However, arm grafts are frequently unsuccessful when the anatomy of the upper extremities is inappropriate for the formation of AVF.

Although the literature supports the safety and effectiveness of femoral access in selected patients, many individuals without suitable upper extremity options rely on tunneled dialysis catheters. This choice probably results from a number of variables, such as a lack of surgical experience creating femoral AV accesses and worries about infection risk because of the anatomical placement of the groin. Historically, femoral grafts have also been associated with high thrombosis rates, with studies reporting poor graft survival, including losses exceeding 50% within the first year[12,13]. Nevertheless, advancements in interventional radiology have reduced the impact of early graft thrombosis, as many grafts can now be salvaged with endovascular interventions even days after thrombosis occurs[14].

This research aims to demonstrate whether femoral AVGs using the profunda femoris artery are a viable and effective choice for carefully selected cases that have exhausted upper extremity vascular access options. The selection of the profunda femoris artery as an inflow source for AV graft construction must be guided by strict criteria to ensure its reliability and long-term patency. Adequate vessel size, sufficient length, and optimal flow volume are essential parameters that must be carefully assessed preoperatively. Adhering to these criteria is crucial to maintaining adequate graft function and minimizing complications. In this study, only profunda femoris arteries meeting these parameters were selected, ensuring that the artery could provide a robust and sustained blood supply. This meticulous selection process underscores the importance of thorough vascular assessment to optimize surgical outcomes and reduce the risk of graft failure or ischemic complications.

Morgan *et al.,* colleagues. reported their experience with 161 individuals who were dialyzed utilizing the

femoral arteries in (1980). However, the initial outcomes of femoral AVG were unsatisfactory. They were all secondary accesses. Despite intensive medical and surgical intervention, 27 femoral triangle infections occurred, resulting in lower limb amputation in 22% of cases and an overall mortality rate of 18%[5].

In 1995, Bhandari and colleagues documented their experience with 46 individuals undergoing 49 PTFE loop thigh grafts. The primary approach of access for nine individuals (18%) was thigh grafts. Every graft worked right away. Graft survival was 70% after three years and 85% after one year. Eleven patients, or 24%, experienced no problems. The other patients experienced infectious (35%) and thrombotic (52%) problems. None of the patients underwent leg amputation with a femoral artery-vein graft implanted. When primary forms have failed or are not feasible, this form of vascular access merits consideration, as reported by Bhandari *et al*.,[15].

Additionally, in their investigation, Dumaine and his colleagues compared 384 patients with fistulas, 22 patients with arm grafts, and 13 patients with femoral grafts. Femoral grafts required more procedures and had greater rates of thrombosis (46% with a thrombotic event). Nevertheless, femoral grafts demonstrated better secondary and functional patency than arm grafts. Comparing femoral grafts with upper extremity fistulas revealed no difference in patency. Antibiotics were only needed for infection in two femoral graft patients, and no grafts were lost due to infection. They showed that femoral grafts could offer an extravascular access alternative for patients with few other options[16].

Another research reviewed 74 polytetrafluoroethylene (PTFE) loop grafts that were performed on 61 individuals in a significant series of groin grafts. Of these, 12 grafts (16%) experienced infection-related problems; there were no severe limb amputations and the graft salvage rate was over 50%[17]. Hence, infection shouldn't be a barrier to using the groin as a location for dialysis access if the sterile technique is strictly followed during cannulation[18].

In this study, we evaluated the profunda femoris artery as an inflow vessel for femoral arteriovenous grafts and analyzed the outcomes. At the end of the first year following surgery, 25 grafts (75.8%) in the profunda group remained patent. Of the 8 grafts lost during this period, 3 losses were due to patient deaths, with all deceased patients having functioning grafts at the time of their death. In the control group, where the superficial femoral artery (SFA) served as the inflow vessel, 27 grafts (69.2%) remained patent for one year. Of the 12 grafts lost, 4 were attributed to patient deaths.

In the current study, we found that both diabetes mellitus (DM) and obesity had a negative impact on the outcomes. DM was present in 7 patients who developed infections and in 8 patients who experienced thrombosis, with these associations being statistically significant ($p<0.002$ and $p<0.01$, respectively). Similarly, obesity was observed in 9 patients who developed wound seromas, 8 patients with edema, and 4 patients with infections, all of which were statistically substantial ($p<0.001$, $p<0.001$, and $p<0.002$, respectively). Based on these findings, excluding such patients from femoral access procedures is preferable.

When access options in the arm are exhausted, many doctors choose tunneled CVC over femoral grafts. Fear of infection in femoral grafts may have played a significant role in this choice. When comparing the long-term results of leg grafts to tunneled internal jugular catheters, Ong *et al*. discovered that leg grafts were better from the standpoints of patency and infection. No catheter lasted more than 900 days, although 38% of leg grafts were still functional after 5 years. Sixty-one percent of leg grafts were infection-free after five years, while no catheters were infection-free for more than two years[8].

Ischemic complications are the most concerning, as they pose significant risks to the limb. In our study, we observed ischemic complications in 7 cases. Four cases experienced arterial steal syndrome and severe claudication, necessitating access ligation. The remaining three cases developed infections and rupture of an anastomotic aneurysm, which required ligation of the superficial femoral artery (SFA) and ultimately resulted in above-knee amputations. Notably, all these complications occurred in the control Group 2. In contrast, no ischemic complications were observed in Group 1, where the profunda femoris artery was used, preserving the vascularity of the limb. This association was statistically significant ($p<0.01$).

Finally, while femoral grafts may be a viable alternative to CVCs for certain cases, they are not appropriate for everyone. For cases with a limited life expectancy, opting for CVC insertion and avoiding additional surgical approaches may be a more suitable choice. Parameters such as poor personal hygiene and obesity can additionally render some cases unsuitable candidates for femoral access. Although studies report low infection rates with femoral access, it is common practice at several centers, involving ours, to utilize patient hygiene as an informal criterion for eligibility. Maintaining a clean access site is critical for any vascular access type involving femoral grafts[16].

LIMITATIONS

Although promising outcomes indicate that femoral grafts utilizing the profunda femoris artery can provide sufficient vascular access, our investigation has many limitations. The primary constraint is the relatively small number of femoral graft cases within our dialysis population. Additionally, the study duration was relatively short, as it was designed to present preliminary findings.

CONCLUSION

In conclusion, our data suggest that hemodialysis access based on the profunda femoris artery is a viable and effective option. The rates of infection and thrombosis are comparable to those observed with superficial femoral artery-based access and upper extremity angioaccess, with no significant risk of ischemic complications. Although the groin is not typically regarded as a first-choice site for dialysis access, it must be regarded as a practical and safe alternative when conventional arteriovenous fistulae in the upper extremity are no longer feasible.

RECOMMENDATIONS

The use of the profunda femoris artery as an effective alternative to other inflow accesses for angioaccess grafts in the groin.

DECLARATION

The manuscript has been read and approved by all the authors. The requirements for authorship of this document have been met. Each author believes that the manuscript represents honest work.

ETHICAL CONSIDERATION

The detailed study protocol was discussed and agreed on by the institutional Ethical Research Committee (Code N-411-2023). After participants were adequately briefed on the study's goals, their written informed consent was obtained. The subject was free to withdraw from the study at any moment; participation was entirely voluntary. In accordance with the Declaration of Helsinki, all steps of data collecting, entry, and analysis were conducted in a highly confidential and private manner.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available on request from the corresponding author. The data are not publicly available as they contain information that could compromise the privacy of research participants.

CONFLICT OF INTERESTS

There are no conflicts of interest.

REFERENCES

1. Sharbidre KG, Alexander LF, Varma RK, Al-Balas AA, Sella DM, Caserta MP, Clingan MJ, Zahid M, Aziz MU, Robbin ML. Hemodialysis access: US for preprocedural mapping and evaluation of maturity and access dysfunction. Radiographics. 2023 Dec 14;44(1):e230053.
2. Brescia MJ, Cimino JE, Appel K, *et al*. Chronic hemodialysis using venipuncture and surgically created arteriovenous fistula. N Engl J Med 1966;275:1089-92.
3. Ratner B. Vascular grafts: technology success/technology failure. BME frontiers. 2023 Jan 16;4:0003.
4. Bhattacharya V, Stansby G. Postgraduate Vascular Surgery: A Candidate's Guide to the FRCS and Board Exams. World Scientific Publishing Company; 2018 Jun 4.
5. Morgan AP, Knight DC, Tilney NL, Lazarus JM. Femoral triangle sepsis in dialysis patients: frequency, management, and outcome. Ann Surg. 1980 Apr;191(4):460-4. doi: 10.1097/00000658-198004000-00012.
6. Torreggiani M, Bernasconi L, Colucci M, Accarino S, Pasquinucci E, Esposito V, Sileno G, Esposito C. Vascular access, complications and survival in incident hemodialysis patients. Kidney and Dialysis. 2021 Sep 30;1(2):88-99.
7. Grapsa E, Pantelias K. Vascular access and new trends. Updates in Hemodialysis. 2016:245-84.
8. Ong S, Barker-Finkel J, Allon M. Long-term outcomes of arteriovenous thigh grafts in hemodialysis patients: a compari son with tunneled dialysis catheters. Clin J Am Soc Nephrol. 2013;8(5):804-809.
9. Lok CE, Huber TS, Orchanian-Cheff A, Rajan DK. Arteriovenous access for hemodialysis: a review. JAMA. 2024 Mar 18.
10. Hicks C, Canner J, Arhuidese I, *et al*. Mortality benefits of different hemodialysis access types are age dependent. J Vasc Surg. 2015;61(2):449-456.
11. Park HS, Choi J, Baik JH. Central venous disease in hemodialysis patients. Kidney research and clinical practice. 2019 Sep;38(3):309.
12. Agarwal, Anil K., *et al*. "Innovations in vascular access for hemodialysis." Kidney international 95.5 (2019): 1053-1063.
13. Piffaretti G, Dorigo W, Castelli P, Pratesi C, Pulli R, Innocenti AA, Giacomelli E, Fargion A, De Blasis G, Scalisi L, Monaca V. Results from a multicenter registry of heparin-bonded expanded polytetrafluoroethylene graft for above-the-knee femoropopliteal bypass. Journal of Vascular Surgery. 2018 May 1;67(5):1463-71.
14. Fujiki M, Hashimoto K, Palaios E, Quintini C, Aucejo FN, Uso TD, Eghtesad B, Miller CM. Probability, management, and long-term outcomes of biliary complications after hepatic artery thrombosis in liver transplant recipients. Surgery. 2017 Nov 1;162(5):1101-11.
15. Bhandari S, Wilkinson A, Sellars L. Saphenous vein forearm grafts and Goretex thigh grafts as alternative forms of vascular access. Clin Nephrol 1995; 44: 325±328.

16. Dumaine C, Espino-Hernandez G, Romann A, Luscombe R, Kiaii M. Femoral arteriovenous grafts for hemodialysis: retrospective comparison with upper extremity grafts and fistulas. Canadian Journal of Kidney Health and Disease. 2017 Jul 14;4:2054358117719747.

17. Khadra M, Dwyer A, Thompson J. Advantages of polytetrafluoroeth ylene arteriovenous loops in the thigh for hemodialysis access. Excerpta Medica 1997;173:280-3.

18. Tashjian DB, Lipkowitz GS, Madden RL, Kaufman JL, Rhee SW, Berman J, Norris M, McCall J. Safety and efficacy of femoral-based hemodialysis access grafts. Journal of vascular surgery. 2002 Apr 1;35(4):691-3.