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 **Original Article** 

# Femoral Vein Transposition Arteriovenous Fistula is a Feasible Option in “Selected” Patients as Hemodialysis Access

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**Introduction:** Lower extremity hemodialysis access is offered to the patients who have severe central venous stenosis. Femoral vein transposition arteriovenous fistula (FV tAVF) is an alternative to lower leg arteriovenous prosthetic grafts. Its safety and patency is under observation.


**Materials and Methods:** This is a retrospective review of patients who had FV tAVF between January 2011 and March 2016. Preoperative clinical findings, intraoperative findings, postoperative complications, and patency of the AVF were noted and analyzed.

**Results:** There were 7 patients who underwent FV tAVF during this study period. Most patients were female (6:1), with mean age of 45.2 years (range, 33–55 years). All patients were hypertensive. Mean body mass index was 26.1 kg/m<sup>2</sup>. Patient had on average previous 6 dialysis accesses. Most patients had preoperative venograms (6/7). Mean interval between initiation of dialysis and creation of the arteriovenous fistula was 1.08 years. All procedures were done under general anesthesia. Four patients required extension of FV with either the small segment of polytetrafluoroethylene or vein graft. Two patients had early postoperative complications. One patient developed hematoma, whereas other had wound dehiscence. All the accesses were utilized for dialysis after a mean interval of 6 weeks. All patients had a patent fistula on average follow-up of 2 years.

**Conclusion:** Appropriate patient selection for FV tAVF can provide good patency with low incidence of complications.

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This can be considered for good risk individuals undergoing their first lower extremity access.

**Keywords:** lower extremity, arteriovenous access, hemodialysis

## Introduction

In patients requiring hemodialysis, the upper limb is the preferred choice for access creation. Unfortunately, due to lack of an optimal health care system in Pakistan, most of the patients for hemodialysis access present late. These patients have central catheters in place. Their forearm veins have already been exhausted due to multiple venipunctures or previously failed hemodialysis accesses. They develop central venous stenosis quite earlier. The lower limb is the next option for creating a dialysis access in patients who have bilateral upper arms central stenosis.

Lower leg prosthetic grafts are reported with a higher incidence of graft and wound infection. Patency is lower because of the early formation of neointimal hyperplasia at the graft-venous anastomosis. They are also associated with higher risk of steal syndrome. One option in the lower extremity is creation of arteriovenous (AV) access using the great saphenous vein. This has not shown good results, likely related to its thick wall and multiple valves acting as a nidus for neointimal hyperplasia. Reports on saphenous vein superficialization demonstrated poor results.<sup>1)</sup>

The femoral vein (FV) is good conduit for creating an AV access. It has proved useful in a variety of settings favoring a large venous conduit.<sup>2-4)</sup> It has a thin wall containing fewer valves compared with the great saphenous vein. FV has been utilized as an autogenous fistula in various centers with acceptable results. The primary and secondary patency for this access has been documented as 91% and 84%<sup>5)</sup> at one year.

The FV is deep seated and has multiple tributaries. It requires extensive dissection for harvesting. Patients on long-term hemodialysis are already nutritionally depleted

and are expected to have higher wound-related issues compared with the normal population. There are many studies mentioning increased incidence of steal syndrome and wound-related complications with this procedure, raising safety concerns for this procedure.<sup>6,7)</sup>

The aim of this study was to determine patency rate and the complications in patients undergoing FV transposition arteriovenous fistula (FV tAVF) at our institute.

## Materials and Methods

This is a retrospective case series. It included patients from January 2011 to March 2016. All those patients who underwent FV tAVF were included in this study. Patients with incomplete follow-up or records were excluded from the study. The study was approved by the institutional ethical review committee (3162-Sug-ERC-14). The data of patients were retrieved from the hospital database using International Classification of Diseases coding system. Designed proforma was filled. Data related to patient demographics, comorbidities, preoperative clinical findings especially arterial and venous systems of the lower extremity, intraoperative findings, and postoperative complications were noted. Patients' files were also reviewed for follow-up visits to evaluate patency of access. Complications such as AV access thrombosis, wound dehiscence, hematoma formation, and leg ischemia were also noted.

At our institute, we prefer upper extremity accesses. Patients are initially evaluated for radiocephalic or brachiocephalic arteriovenous fistulae. These are our first choices. If both options are not available, patients are evaluated for basilic transposition arteriovenous fistula either in the forearm or most commonly in the upper arm. If both basilic veins are not available, patients are considered for forearm or upper arm prosthetic grafts. Patients are also considered for axillo-axillary arteriovenous grafts before offering lower extremity accesses. Our preference in the lower leg is more for FV tAVF than the prosthetic grafts.

In this case series, those patients were included who had exhausted upper arm veins and have bilateral upper arm central venous stenosis. All patients had preoperative bilateral upper extremity venogram to check for central venous stenosis. Preoperative venous mapping of lower extremity veins were also performed in all patients. Patients with the previous history of deep venous thrombosis were not offered this operation. Same was true if they had arterial insufficiency. Specific history for intermittent claudication and detailed peripheral arterial examination was done. Only patients with no history of arterial insufficiency and palpable ankle pulses were offered this procedure. Preoperative venogram of lower extremity was also performed to rule out if the patient had a history of femoral cannulation. This is to rule out iliac venous

stenosis. The surgery followed the technique described by Gradman et al. in 2001<sup>8)</sup> and 2005.<sup>9)</sup> A longitudinal incision from the inguinal crease to just above the knee was made to harvest the FV. After division of subcutaneous tissue, the sartorius muscle was identified. This was well mobilized to harvest underlying vein. Care was taken to preserve as many femoral artery branches as possible. Vein tributaries were double ligated. The vein was dissected free from its junction to the profunda femoris vein proximally to beyond the adductor hiatus distally. The length of the vein harvested depended on the size of the patient: thinner patients required lesser vein than obese patients. A subcutaneous tunnel was created in the anterolateral thigh. The vein was later placed in this tunnel. The vein was transposed superficially and anastomosed to the distal femoral artery. Tapering of the vein was done in patients when there was a discrepancy between the diameter of the FV and the artery. If required, a small segment of the prosthetic graft was used to obtain an appropriate size of the vein. Same was the approach if the length of the dissected vein became inadequate for making the anastomosis comfortably. This does happen in patients having relatively thick subcutaneous tissue. The wounds were closed in two layers over a suction drain. Patients were closely observed for immediate postoperative complications especially steal syndrome, bleeding, graft thrombosis, or venous insufficiency. They were kept inpatient and discharged when fully mobilized and stable. Patients were followed in the clinic after 1 week to evaluate fistula patency and to detect wound-related complications. If everything is fine, patients were followed after 5 weeks to check the maturation of access. If matured, accesses were allowed for cannulation. Patients were followed after every 6 months and then annually. This is to detect any developing complications and needling issue.

Data were entered and analyzed using SPSS version 19. Quantitative variables were reported as mean  $\pm$  standard deviation, or median with interquartile ranges, depending upon the distribution of the data. Qualitative variables were reported and expressed as proportion and percentage of patients.

## Results

Seven patients underwent FV tAVF during this study period. Most of the patients were female (6:1). Mean age was 45.2 years (range, 33–55 years). All patients were hypertensive (Table 1). The mean interval between the initiation of dialysis and creation of the FV tAVF was 1.08 years. Six patients had venogram to rule out any stenosis in the iliac veins preoperatively. Particulars related to American Society of Anesthesiologists type, type of anesthesia and types of the incision are given in Table 2.

**Table 1** Preoperative patient characteristics

Variables	N=7
Average age in years (range)	45.2 (35.0–55.0)
Females	6 (85.0%)
Diabetes mellitus	1 (14.3%)
Hypertension	7 (100%)
Ischemic heart disease	1 (14.3%)
Hypothyroid	1 (14.3%)
Hepatitis C	1 (14.3%)
Infective endocarditis	1 (14.3%)
Tuberculosis	1 (14.3%)
Mean body mass index (kg/m <sup>2</sup> ) (range)	26.4 (25.0–30.0)
Previous history of femoral dialysis catheters	1 (14.3%)
Venograms of lower legs	6 (85.7%)
Mean number of dialysis accesses	6

**Table 2** Perioperative details

Variables	N=7
Mean ASA grade	2.85
Type of anesthesia	
a. General anesthesia	7 (100%)
Type of incision	
a. Standard longitudinal	6 (85.7%)
b. Skip incision	1 (14.3%)
Extension of FV by	
a. Prosthetic (PTFE) graft	3 (42.8%)
b. Autologous (GSV) graft	1 (14.3%)

ASA: American Society of Anesthesiologists; FV: femoral vein; PTFE: polytetrafluoroethylene; GSV: great saphenous vein

**Table 3** Postoperative complications

Complication	N=7
Hematoma	1
Wound dehiscence	1
Steal syndrome requiring intervention	0
Venous swelling requiring fasciotomy	0
Iliac vein angioplasty/stenting	1

**Table 4** Follow-up of patients

Patient no.	Total follow up (in years)	Fistula patent (yes/no)	Any intervention needed
1	1	Yes	—
2	3	Yes	Iliac vein angioplasty Iliac vein stenting
3	3	Yes	—
4	2.5	Yes	—
5	2	Yes	—
6	1	Yes	—
7	1	Yes	—

Two patients developed postoperative complications (Table 3). One patient developed hematoma and did require exploration to evacuate it. She was on therapeutic oral anticoagulation, which was stopped before the operation. Perioperatively, there was no active bleeding point identified. One patient had wound dehiscence, which required washout and partial closure of the wound. All the patent accesses were utilized for dialysis after a mean interval of 6 weeks. One patient developed central venous stenosis 6 months later and underwent iliac vein stenting. All the patent accesses were utilized for dialysis after a mean interval of 6 weeks. All patients had a patent fistula on average follow-up of 2 years. Primary patency was 85%, and primary-assisted patency was 100% (Table 4).

## Discussion

Patients who have exhausted upper extremity veins or have developed central venous stenosis require an alternate site for hemodialysis access creation.<sup>10)</sup> The alternate choice can be the lower limbs where a graft or an autogenous fistula can be formed. Autogenous access can be created using either the great saphenous vein (GSV) or the FV. Prosthetic grafts are inferior as they have a higher incidence of infection<sup>11)</sup> and lesser patency compared with autogenous access. In one series of 45 patients using either polytetrafluoroethylene (PTFE) (n=39) or bovine graft (n=6), the 2 year primary patency rate was 47% with an infection rate of 18%.<sup>12)</sup> Unfortunately, GSV also has shown poor patency.<sup>13,14)</sup> This is likely due to its relatively thick wall and reduced chances of maturation.

In this study, there was 1 patient who had a major wound dehiscence requiring formal washout and partial closure of the wound. Fortunately, the anastomosis was well protected by the overlying sartorius muscle. The patient had a usable fistula after 6 weeks.

To decrease wound-related complications, skip incision technique is also advocated. In 1 patient in the latter half of the series, skip incision technique was used instead of a longitudinal incision. Alcocer et al. showed wound morbidity can be reduced by using small skin incision technique. They compared a cohort of 12 patients with FV tAVF created with standard technique versus 13 patients with FV tAVF created with modified small incision technique. By modified technique, they mean small about 12 cm mid-thigh incision. In the standard technique, 5 patients had wound-related complications, whereas no patient had a wound-related complication in the modified group. Patency was similar in both groups.<sup>15)</sup>

Another problem is size discrepancy between the FV which is usually more than 10 mm and the superficial femoral artery. Creating a wider anastomosis always places these patients to the risk of steal syndrome. The

presence of arterial occlusive disease in the lower extremity also contributes to these patients for developing steal syndrome. Fortunately, none of our patients developed severe steal. When FV tAVF was first described in 2001, there was initially a higher incidence of lower extremity ischemia. This complication was subsequently resolved by improved technique (tapered FV, distal femoral artery pressure measurement, and fasciotomy) and improved patient selection (avoiding surgery in patients with a significant occlusive disease).

Preoperatively, all patients had normal arterial supply with palpable ankle pulses. Anastomoses were not more than 5–6 mm in size. It was made possible by either tapering the vein end or using a small piece of PTFE as interposition graft. In order to get an adequate length in 1 patient, a small segment of reversed GSV was used, usually harvested from the same wound.

Patients were followed for any fistula failure or central venous stenosis. One patient developed limb swelling. This was due to progressive iliac vein stenosis. Although she was initially treated with balloon angioplasty, it recurred, later treated with self-expanding stent. Although there is potential for significant venous morbidity, Wells et al. have reported fairly minimal long-term venous morbidity using sophisticated venous imaging.<sup>16)</sup> No patient developed significant venous swelling in this study. Sidawy et al. emphasized that venous obstructive complications can range from mild distal edema to compartment syndrome.<sup>17)</sup> These complications can be minimized when harvesting of the vein is limited to the anatomical segment proximal to the popliteal vein.

The flow rate in FV tAVF is higher than the upper arm accesses. There is always a risk that they may develop signs of heart failure. At the 2 years follow-up, fortunately no patient developed signs or symptoms of heart failure. Jackson pointed out that flow rates in two of his reported patients with FV tAVF were substantially higher (2000 mL/min) than generally observed in upper-arm grafts, but congestive heart failure did not develop in either patient.<sup>18)</sup>

Patients with peripheral vascular disease and cardiac failure are not good candidates for this procedure. One has to be very careful in selecting patients for FV tAVF.

## Conclusion

Although FV tAVF is associated with significant wound-related and ischemic complications, we have found in this study that careful selection of patients can lead to a favorable outcome. We suggest that FV tAVF be considered in “selected” patients as an alternative before the lower leg prosthetic grafts.

## Disclosure Statement

There is no conflict of interest noted.

## Author Contributions

Study conception: ZUR, ZS

Data collection: AA, ZUR

Writing: ZUR

Funding acquisition: nil

Critical review and revision: ZUR

Final approval of the article: all authors

Accountability for all aspects of the work: all authors

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