

# Outcome of Arteriovenous Fistula Following Renal Transplantation

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## Keywords

Renal transplantation, arteriovenous fistula, AVF thrombosis, kidney transplant complications, vascular access management, AVF patency, end-stage renal disease, haemodialysis access, post-transplant care.

## Disclaimers

Authors' Contributions

Shuah Ullah, Muntaha Samad, and Shariq Bin Yousuf conceived and designed the study; Muntaha Samad and Shuah Ullah acquired and analyzed the data; Bilal Masood, Tanzeel Gazder, Abdul Khaliq, Bux Ali, and Zaid Sophie critically reviewed and approved the manuscript.

## Conflict of Interest

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## ABSTRACT

**Background:** Renal transplantation is the preferred treatment for end-stage renal disease (ESRD), but the management of arteriovenous fistulas (AVFs) post-transplant remains controversial due to complications like thrombosis.

**Objective:** To determine the outcome of AVFs following renal transplantation, focusing on the incidence and timing of AVF thrombosis.

**Methods:** This Ambi-directional cohort study included 155 patients with ESRD who underwent kidney transplantation at the Sindh Institute of Urology and Transplantation, Karachi, in 2021. All included patients had functional AVF at the time of transplantation. Data were collected from electronic health records, including demographic information, AVF characteristics, and incidence of thrombosis. AVF outcomes were monitored through follow-up assessments until September 2024. Statistical analysis was conducted using SPSS version 25, with significance set at  $p < 0.05$ .

**Results:** Thrombosis occurred in 71 (45.8%) patients, most frequently within one week (14.8%), within four weeks (21.9%), and within one year (34.2%). Surgical ligation was required in 5 patients (3.22%). No significant associations were found between thrombosis and age, comorbidities, or AVF type ( $p > 0.05$ ).

**Conclusion:** AVF thrombosis is a frequent complication post-transplant, not significantly influenced by patient demographics or AVF type, highlighting the need for continued surveillance.

## INTRODUCTION

Renal transplantation is considered the most effective and cost-efficient treatment for patients suffering from end-stage renal disease (ESRD). Compared to patients who remain on dialysis, those who undergo successful kidney transplantation experience significantly enhanced quality of life and extended survival rates exceeding ten years (1, 2, 3). Before receiving a kidney transplant, patients with ESRD typically have an arteriovenous fistula (AVF) placed for haemodialysis, which is the preferred vascular access method according to the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines, particularly in regions with limited organ donation opportunities (4, 5). While an AVF usually remains functional post-transplant, it is often not utilized, and current guidelines lack clear recommendations on whether to ligate or preserve AVFs following successful kidney transplantation (6, 7). Recently, the National Kidney Foundation emphasized the importance of personalized vascular access management plans for ESRD patients, addressing complications associated with AVF treatment (8). In contrast, European best practice guidelines suggest that routine AVF ligation is unnecessary, although ligation may improve clinical outcomes in certain contexts, such as enhancing cardiac function (9).

Despite successful transplantation, AVFs can develop complications, including thrombosis, aneurysms, high-

flow fistulas, and steal syndrome. Thrombosis, in particular, is a common issue leading to AVF failure and requiring clinical intervention (10). In some cases, a patent AVF may be employed post-transplant for haemodialysis, plasmapheresis, or intravenous fluid administration in scenarios like delayed graft function or graft rejection. The functional longevity of a kidney transplant is limited, and should the graft begin to fail, patients may need to reinstate haemodialysis, necessitating vascular access if the original AVF has been ligated. Spontaneous thrombosis remains the leading cause of AVF closure, often progressing to thrombophlebitis, which necessitates hospitalization, intravenous antibiotics, and sometimes surgical removal of the affected vein. Identifying the specific type of thrombosed AVF and understanding its physiological impacts are crucial for effective management (11).

Previous studies have highlighted the prevalence of AVF-related complications post-transplant. For example, a retrospective study found that approximately 29% of kidney transplant recipients experienced AVF complications, with thrombosis occurring in 76% of these cases (12). This emphasizes the need for ongoing AVF surveillance post-transplant to address potential issues proactively, even if reduced monitoring is recommended. Furthermore, research suggests that AVF closure after kidney transplantation may enhance graft function and reduce recurrent graft loss, underscoring the complex

considerations in post-transplant vascular access management (13).

This study aims to evaluate the outcomes of AVFs in kidney transplant recipients at the Sindh Institute of Urology and Transplantation, Karachi, Pakistan. It focuses on the incidence of AVF thrombosis post-transplant and explores the broader implications for patient management and clinical decision-making. Understanding the prevalence and nature of AVF complications can guide improvements in postoperative care and help refine clinical strategies to mitigate risks, ultimately enhancing patient outcomes in this population. Notably, this is the first study of its kind conducted in Pakistan, offering valuable insights into the management of AVFs in the local context.

**MATERIAL AND METHODS**

The study was conducted as an ambi-directional cohort analysis of patients with end-stage renal disease who underwent kidney transplantation at the Sindh Institute of Urology and Transplantation (SIUT) in Karachi, Pakistan, between January 1, 2021, and December 31, 2021. The study population included all patients who met the inclusion criteria of having a functional arteriovenous fistula (AVF) at the time of transplantation, resulting in a total sample size of 155 patients. The sampling method used was a consecutive non-probability technique. Patients without a functioning AVF at the time of transplantation were excluded from the study.

Data were collected retrospectively from electronic health records (EHR) maintained by the hospital. The information gathered included demographic details such as age at the time of transplant, gender, underlying cause of renal failure, presence of comorbidities, and specific AVF characteristics, including the type of AVF, its functional status, reasons for AVF failure, date of thrombosis, and any medical or surgical interventions performed. In cases where medical records were incomplete, patients were contacted directly to gather missing information about the status of their AVFs.

The assessment of AVF outcomes was performed by reviewing patient follow-up data up to September 2024. Following transplantation, patients were discharged on the 11th postoperative day, according to standard clinical protocols. Follow-up visits occurred initially at two weeks post-transplant, followed by subsequent visits at one month, and then every three months in the transplant outpatient department (OPD). During each visit, nephrologists evaluated AVF patency, and if complications were suspected, vascular access specialists conducted a thorough examination, which included clinical assessments and radiographic imaging when necessary. The primary objective of the study was to assess the long-term functionality of AVFs following kidney transplantation. A secondary objective was to identify the occurrence and timing of thrombosis in specific types of AVFs. Ethical approval was obtained from the Institutional Review Board (IRB) of SIUT, while the study was conducted in accordance with the ethical standards of the Declaration of Helsinki. The IRB number for this study was 562, and additional ethical clearance was provided by the ethical review committee under reference number SIUT-ERC-2024/A-506.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 25. Continuous variables, such as age, were reported as mean values with standard deviations, while categorical variables, including gender, comorbidities, reasons for renal failure, AVF types, and AVF patency status, were presented as frequencies and percentages. Statistical significance was set at a p-value of less than 0.05, with a confidence interval of 95%. The analysis aimed to provide a comprehensive overview of AVF outcomes and the factors influencing AVF patency and complications among kidney transplant recipients.

**RESULTS**

The study included 155 patients who underwent kidney transplantation at the Sindh Institute of Urology and Transplantation, Karachi,

**Table 1: Age Distribution of Patients**

Age Range	Frequency	Percent
<20 years	12	7.7
20-30 years	66	42.6
31-40 years	53	34.2
41-50 years	18	11.6
51-60 years	6	3.9

Regarding comorbidities, most patients had hypertension (83.2%), with a smaller proportion

having both hypertension and diabetes (7.1%), and 9.0% having no comorbid conditions (Table 2).

**Table 2: Comorbidities of Patients**

Comorbidity	Frequency	Percent
Diabetes Mellitus (DM)	1	0.6
Hypertension (HTN)	129	83.2
Hypertension and DM	11	7.1
None	14	9.0

with a functioning arteriovenous fistula (AVF) at the time of the transplant. The mean age of the patients was 31.29 ± 9.16 years, ranging from 14 to 55 years. The age

distribution and associated frequencies are summarized in Table 1. The majority of the participants (42.6%) were

aged between 20-30 years. Of the total participants, 125 (80.6%) were male, and 30 (19.4%) were female. The causes of renal failure varied among the patients, with chronic sclerosing glomerulonephritis

being the most known cause (20.6%). However, in nearly half of the patients (48.4%), the cause of renal failure was unknown (Table 3).

**Table 3: Causes of Renal Failure**

Cause of Renal Failure	Frequency	Percent
Chronic Sclerosing GN	32	20.6
Congenital Disease	2	1.3
Cystic Kidney Disease	8	5.2
Diabetic Nephropathy	1	0.6
Hypertension	22	14.2
Unknown	75	48.4
Obstructive Nephropathy	15	9.7

The types of AVFs were predominantly on the left side, with 86.45% of patients having a left-sided fistula. The most common AVF type was the left

radio-cephalic fistula, comprising 56.1% of the total (Table 4).

**Table 4: Types of AVF**

Type of AVF	Frequency	Percent
Left Brachio-Basilic	14	9.0
Left Brachio-Cephalic	33	21.3
Left Radio-Cephalic	87	56.1
Right Brachio-Basilic	3	1.9
Right Brachio-Cephalic	8	5.2
Right Radio-Cephalic	9	5.8
Right SFVT	1	0.6

During the three-year follow-up period, 71 (45.8%) patients experienced spontaneous thrombosis of their AVF. Thrombosis occurred most frequently within the first week post-transplant (14.8%), followed by occurrences within four weeks (21.9%), within one year (34.2%), and after one year (11.6%). Thrombosis was confirmed using color Doppler ultrasonography, and common symptoms included erythema, pain, and edema along the fistula vein.

Surgical intervention was required for five patients (3.22%) who presented with persistent symptoms unresponsive to conservative treatment. These interventions included ligation of the thrombosed AVF under general anesthesia.

The associations between thrombosis and various factors such as age, comorbidities, and AVF type were analyzed. The results showed no significant association between thrombosis and these variables, as indicated by the p-values listed in Table 5.

**Table 5: P-values for Associations Between Thrombosis and Clinical Factors**

Comparison	P-value
Age vs Thrombosis	0.73
Comorbidities vs Thrombosis	0.67
AVF Type vs Thrombosis	0.70

These findings suggest that thrombosis post-transplant was not significantly influenced by the patients' age, comorbidities, or AVF type, highlighting the need for broader surveillance and individualized patient management strategies regardless of these baseline factors. The study emphasizes the importance of continued AVF monitoring post-transplant, albeit with potentially reduced frequency, to promptly identify and manage complications.

**DISCUSSION**

The findings of this study highlighted the significant occurrence of arteriovenous fistula (AVF) thrombosis in

kidney transplant recipients, with nearly half of the patients experiencing thrombosis during the three-year follow-up period. This aligns with previous research that identified AVF thrombosis as a common complication following renal transplantation, underscoring the need for ongoing surveillance and management of vascular access in these patients (12). The high rate of spontaneous thrombosis observed, particularly within the first year post-transplant, suggests that while AVFs may remain patent initially, they are susceptible to complications that can compromise their functionality and patient outcomes.

The study observed that the occurrence of thrombosis was not significantly associated with factors such as age,

comorbidities, or AVF type. These results are consistent with previous studies, such as those by Patard et al. and Vajdic et al., which also reported that AVF thrombosis rates were not significantly affected by these demographic or clinical factors (14, 15). This suggests that other, less apparent variables, possibly including individual patient characteristics or specific post-transplant management protocols, may play a more critical role in influencing AVF outcomes.

One of the notable findings was the frequency of AVF thrombosis among patients with radio-cephalic fistulas, which was higher compared to other AVF types. This observation is important as it may influence the choice of AVF type in clinical practice, especially considering the need for reliable long-term vascular access in patients who may require future dialysis due to graft failure. Moreover, the high incidence of AVF thrombosis in this study, particularly within the first week post-transplant, highlights the importance of immediate and vigilant post-operative monitoring to mitigate early complications. The identified factors, such as compromised hemodynamic stability and the cessation of heparin administration post-transplant, could contribute to early AVF thrombosis, as described in other studies (16).

The results also indicated that AVF ligation was necessary in a small proportion of patients whose symptoms were refractory to conservative management. The decision to ligate AVFs remains controversial, with some guidelines suggesting that maintaining AVF patency can be beneficial for potential future needs, such as dialysis in cases of graft failure or therapeutic plasma exchange (9, 13). The potential benefit of ligation in improving cardiac function and reducing cardiovascular load has been supported by some studies, but these benefits must be weighed against the risks of losing a viable vascular access, especially in patients who might eventually return to dialysis (11).

The strengths of this study include its focus on a specific patient population within a defined clinical setting, providing valuable local data on AVF outcomes post-renal transplantation. However, several limitations must be acknowledged. The study was retrospective in nature, which inherently limits the ability to establish causality between observed factors and outcomes. Additionally, the relatively small sample size and the single-center design may limit the generalizability of the findings to broader populations. There was also a lack of detailed data on other potential confounders, such as the precise timing and duration of immunosuppressive therapy, which could have impacted AVF patency rates.

Further research is recommended to explore the underlying mechanisms that contribute to AVF thrombosis in kidney transplant patients, including prospective studies that incorporate larger, multi-center cohorts to validate these findings. Investigating the role of individualized patient management strategies, particularly in the early post-transplant period, could provide insights into optimizing AVF outcomes. Moreover, developing specific guidelines for the management of AVFs post-transplant, including clear recommendations on surveillance protocols and criteria for ligation, would be beneficial in standardizing care and improving patient outcomes.

## CONCLUSION

In conclusion, this study confirmed that AVF thrombosis is a prevalent complication among kidney transplant recipients and is not significantly associated with commonly considered factors such as age, comorbidities, or AVF type. These findings support the need for continued AVF monitoring post-transplant and suggest that individual patient factors and tailored management strategies may be critical in mitigating AVF complications. Future research should aim to refine these strategies and address the current gaps in clinical guidelines to better support transplant recipients in managing their vascular access.

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