



NATIVE UPPER LIMB ARTERIOVENOUS FISTULA FOR
HEMODIALYSIS: SINGLE-CENTER EXPERIENCE IN IRAQ.
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Abstract

Background: Native arteriovenous fistulas (AVFs) remain the preferred vascular access for hemodialysis due to superior patency and lower complication rates. This study evaluates the success, complication rates, and clinical outcomes of AVF creation in patients with end-stage renal disease (ESRD) at a tertiary hospital in Baghdad, Iraq. **Patients and Methods:** A prospective study was conducted from April 2023 to April 2024, involving 75 ESRD patients (42 males, 33 females), aged 12 to 98 years, who underwent upper limb AVF creation. Comprehensive demographic, clinical, and procedural data were collected through patient interviews, physical exams, and systematic documentation in a customized Microsoft Access database. The primary procedure was performed under local anesthesia, and patients were followed for up to six months. **Results:** Successful AVF creation was achieved in 89.3% of cases, with primary failure occurring in 10.7%. Complications were rare, with distal edema (8%), thrombosis (8%), oozing (4%), arterial steal syndrome (2.7%), and an AVF aneurysm (1.3%) reported. Secondary interventions, including thrombectomy (5.3%) and false aneurysm exploration (2.7%), were required in a small number of patients. No fatalities were observed. The average hospital stay was 6.4 hours, with most patients discharged within 4 hours of surgery. **Conclusions:** Upper limb native AVF creation is a safe and effective procedure for ESRD patients, with a high success rate and low complication and mortality rates. Brachio-cephalic AVF (BCAVF) patients exhibited higher complication rates compared to radio-cephalic AVF (RCAVF). Early discharge and short hospital stays were typical, highlighting the procedure's minimal postoperative burden.

Keywords: [End-stage renal disease](#), [Arteriovenous fistula](#), [upper limb](#), [Radiocephalic](#), [Brachiocephalic](#)

Main Subject: [Urology](#)

Introduction

End-stage renal disease (ESRD) is a life-threatening condition that requires renal replacement therapy, with hemodialysis being the most common intervention worldwide.^{1,2} Hemodialysis remains the most widely used treatment modality, and the creation of a reliable vascular access is essential for its success. Among the available options, native arteriovenous fistulas (AVFs) are considered the gold standard due to their superior long-term patency, lower risk of infection, and reduced incidence of thrombosis compared to synthetic grafts and central venous catheters.³

The upper limb is the preferred site for native AVF construction, with the radiocephalic (RCAVF) and brachiocephalic (BCAVF) configurations being the most commonly performed. Despite their advantages, AVFs are associated with potential complications, including failure to mature, thrombosis, infection, and aneurysm formation. The success of AVF creation depends on multiple factors, such as patient selection, vascular anatomy, surgical technique, and postoperative care.^{3,4}

This study presents a single-center (Al-Kadimiyah Teaching Hospital, Baghdad) experience with upper limb native AVF creation for hemodialysis, evaluating

complication rates and identifying factors influencing AVF outcomes. By comparing our findings with existing literature, we aim to provide recommendations for optimizing patient selection, surgical approaches, and postoperative management in accordance with international best practices.

Patients and Methods

A prospective study was conducted over one year (April 2023 – April 2024) involving 75 patients with ESRD, including 42 males and 33 females, who underwent upper limb native AVF creation for hemodialysis at Al-Kadimiyah Teaching Hospital, Baghdad, Iraq. The patients' ages ranged from 12 to 98 years, and all surgeries were performed by the same surgical team. Written informed consent was obtained from all participants.

Demographic and clinical data were collected through patient interviews and physical examinations, and systematically entered into a Microsoft Access database. Clinical evaluations included assessments for comorbidities such as diabetes, hypertension, and peripheral arterial disease. Allen's test was performed to ensure palmar arch

patency, and superficial veins, particularly the cephalic vein, were examined.

Most procedures were performed under local anesthesia, using radio-cephalic or brachio-cephalic AVFs with artery-side to vein-end anastomoses. Patients were typically discharged within 24 hours if there were no immediate complications. Follow-up care continued for six months

during regular hemodialysis, with any complications documented.

A customized Microsoft Access database was used to collect and organize patient data, allowing for efficient management and retrieval of relevant datasets, such as complication rates, fistula patency, and patient characteristics, for statistical analysis.

Results

This study included 75 patients with ESRD who underwent native AVF creation for hemodialysis. The cohort consisted of 42 males (56%) and 33 females (44%), with a male-to-female ratio of 1.27:1 ($P = 0.07186$, not statistically significant).

Table I displays the age and sex distribution of the patients. The patients' ages ranged from 12 to 98 years, with a mean age of 52.04 ± 17.77 years. The majority (69.3%) were in the 5th–7th decades of life, while children (6.7%) and elderly patients over 70 years (10.7%) were less common. The mean age for males and females was nearly identical (52.09 ± 15.09 years and 52 ± 21 years, respectively). Notably, all pediatric patients and most elderly individuals (6 out of 8) were female.

Table I: Age and sex distribution of the patients.

Age (years)	Males (n, %)	Females (n, %)	Total (n, %)
10-20	0 (0)	5 (6.7)	5 (6.7)
21-30	7 (9.3)	1 (1.3)	8 (10.7)
31-40	0 (0)	2 (2.7)	2 (2.7)
41-50	9 (11.7)	6 (8.1)	15 (20)
51-60	12 (16.2)	7 (9.3)	19 (25.3)
61-70	12 (16.2)	6 (8.1)	18 (24)
71-80	2 (2.7)	5 (6.7)	7 (9.3)
81-90	0 (0)	0 (0)	0 (0)
91-100	0 (0)	1 (1.3)	1 (1.3)
Total	42 (56)	33 (44)	75 (100)

Nearly one-third of the patients (34.7%) were unemployed, and another 30.7% were housewives. The remaining participants included self-employed individuals (22.7%), students (5.3%), teachers (2.7%), civil servants (2.7%), and a veterinarian (1.3%). Only 6.7% of patients had a fixed salary.

The duration of ESRD ranged from less than one year to 10 years, with a mean of 2.9 years. More than half of the patients (54.7%) had ESRD for 2–3 years before AVF creation. All patients had a central venous catheter (CVC) prior to the procedure, predominantly on the right side (85.3%), with the right internal jugular vein (IJV) being the most commonly accessed site (69.3%). The P-value for catheter side distribution was <0.00001, indicating statistical significance. The sites and sides of these CVCs are shown in **Table-II**.

Table II: The Sites and Sides of CVCs Before AVF Creation in This Series

Site & Side of CVC	Males (n, %)	Females (n, %)	Total (n, %)	P value
No CVc	0 (0)	0 (0)	0 (0)	
R IJV	28 (37.3)	24 (32)	52 (69.3)	0.4354. (non-significant)
R femoral vein	5 (6.7)	2 (2.7)	7 (9.3)	0.1096 (non-significant)
R Subclavian vein	3 (4)	2 (2.7)	5 (6.7)	0.5287 (non-significant)
L IJV	1 (1.3)	3 (4)	4 (5.3)	0.15854 (non-significant)
L Subclavian vein	3 (4)	0 (0)	3 (4)	0.01428 (significant)
L femoral vein	2 (2.7)	2 (2.7)	4 (5.3)	1 (non-significant)
Total	42 (56)	33 (44)	75 (100)	

Local anesthesia was used in 92% of cases (n=69), while general and regional anesthesia were each administered in 4% of cases (n=3 each). Most patients (84%) underwent a single AVF creation, whereas 16% required a second attempt due to initial failure. The preferred anastomotic technique was end-to-side (98.7%), with only one case (1.3%) utilizing a side-to-side configuration. Intraoperative heparinization was routinely performed using 5,000 IU of unfractionated heparin (UFH) intravenously, along with heparinized saline for vessel irrigation. In terms of AVF types, 84% of patients underwent brachiocephalic AVF creation, while 13.3% had radiocephalic AVFs. The types of AVFs are shown in **Table-III**.

Table-III: Types of AVF

Type of AVF	Male	Female	Total (n, %)	P value
R radiocephalic	2 (2.7)	1 (1.3)	3 (4)	0.41222 (not-significant)
L radiocephalic	5 (6.7)	2 (2.7)	7 (9.3)	0.1096 (not-significant)
R brachiocephalic	8 (10.7)	10 (13.3)	18 (24)	0.50286 (not-significant)
L brachiocephalic	26 (34.7)	19 (25.3)	45 (60)	0.13888 (not-significant)
Transposed basilic vein AVF	1 (1.3)	1 (1.3)	2 (2.7)	1 (not-significant)
Total	42 (56)	33 (44)	75 (100)	0.14156 (not-significant)

Only 2.7% had transposed basilic vein AVFs. Additionally, AVFs in the elbow region were significantly more common than those in the wrist ($P < 0.00001$). The left side was more frequently chosen for both brachiocephalic and radiocephalic AVFs, with a significant preference for the left side in brachiocephalic AVFs ($P < 0.00001$), but no significant side preference was found for radiocephalic AVFs ($P = 0.07346$). Secondary interventions included thrombectomy in 4 cases (5.3%), exploration of a false aneurysm with vessel ligation in 2 cases (2.7%), re-exploration due to bleeding in 1 case (1.3%), and fistula banding for arterial steal syndrome in 1 case (1.3%).

All patients were discharged on the same day as their surgery. Hospital stays ranged from 3 to 48 hours, with an average stay of 6.4 hours; most patients (76%) were discharged after 4 hours. Despite the complications, no fatalities were reported during the follow-up period, although it was brief.

In addition to the eight primary AVF failures, most patients had a successful recovery, with only a few experiencing complications. **Table IV** shows the complications.

Table IV: The Complications vs. Type of AVF

Complication	R RCAVF	L RCAVF	R BCAVF	L BCAVF	P value
Primary Failure	0	0	3	5	0.00006
Thrombosis	0	0	3	3	0.00054
Distal Oedema	0	0	1	5	0.00054
Ooze	0	0	2	1	0.0455
Arterial Steal Syndrome	0	0	0	2	0.01428
AVF Aneurysm	0	0	0	1	0.15854

Distal edema and thrombosis were observed in six patients each (8%), oozing in three patients (4%), arterial steal syndrome in two patients (2.7%), and an AVF aneurysm in one patient (1.3%). Notably, no complications were associated with radiocephalic AVF (RCAVF), and all complications were exclusively observed in patients who underwent brachiocephalic AVF (BCAVF), with a statistically significant difference.

Discussion

Chronic kidney disease (CKD) is a progressive condition characterized by a gradual decline in kidney function over time. While patients with CKD may retain some residual renal function, ESRD represents the most severe form, necessitating renal replacement therapy through dialysis or kidney transplantation.⁵ Effective vascular access is crucial for hemodialysis, with AVFs being the preferred modality due to their superior long-term patency and lower complication rates.⁶

This study prospectively evaluated 75 patients undergoing native AVF creation for hemodialysis. The male predominance (56% vs. 44%) observed in our cohort aligns with global findings, as ESRD has been reported to occur 50% more frequently in men than in women.⁷ The mean age of our patients (52 years)

was similar across genders, and the highest incidence of ESRD was seen in the 5th to 7th decades of life. These findings support Tamura's report that ESRD affects individuals across all age groups but becomes more prevalent in the elderly, with half of new hemodialysis patients being over 65 years old.⁸

A unique aspect of this study was the inclusion of pediatric patients (6.7%) and individuals over 70 years (10.7%). Age is an important factor influencing AVF patency, as younger patients may have smaller vessels, while elderly individuals frequently present with multiple comorbidities that may compromise fistula maturation.⁹ However, despite these concerns, our study found no AVF failures in pediatric patients, and all elderly patients, except one, successfully underwent AVF creation. This reinforces

the notion that age alone should not be a contraindication for AVF creation.¹⁰

The economic burden of ESRD in developing countries is significant due to the high costs of dialysis and limited insurance coverage.¹¹ In our cohort, only 6.7% had stable incomes, with most patients being either unemployed or housewives. This financial strain is exacerbated by the average ESRD duration of 2.9 years, highlighting the urgent need for healthcare support and improved insurance systems.

All patients in this study had central venous catheters (CVCs) before AVF creation, with the right internal jugular vein (IJV) being the most common access site (69.3%). The right IJV is preferred due to its direct pathway to the superior vena cava and lower risk of pneumothorax.¹² The subclavian vein was used exclusively in males (4%), despite recommendations to avoid it due to the risk of central vein stenosis.³ The femoral vein was used in 14.6% of cases, primarily in critically ill or bedridden patients; however, this site carries a higher risk of infection and thrombosis.¹³

Viral infections such as hepatitis B and C pose a challenge in hemodialysis settings due to the risk of transmission.¹⁴⁻¹⁶ In this study, two patients had hepatitis B and two had hepatitis C, emphasizing the need for stringent infection control measures in dialysis units.

The majority of procedures were performed under local anesthesia (92%), with end-to-side anastomosis (98.7%) being the standard technique. This aligns with international best practices.¹⁷ The preference for the left upper limb (70.7%)

was due to the predominance of right-hand dominance (93.3%), as using the non-dominant arm minimizes the risk of functional impairment.^{1,3}

Brachiocephalic AVFs were significantly more common than radiocephalic AVFs (84% vs. 13.3%, $P < 0.00001$). This finding is consistent with previous studies showing that BCAVs are technically easier to construct and mature faster.¹⁵ However, while RCAVs are generally preferred due to their lower complication rates, limited suitable wrist veins may necessitate the use of BCAVs.^{2,18,19}

Interestingly, all complications in this study occurred in BCAV cases, whereas RCAVs had no reported complications, a statistically significant finding. This is contrary to prior research indicating that BCAVs tend to have lower complication rates than RCAVs (15). The most frequent complications observed were distal edema (8%), thrombosis (8%), oozing (4%), steal syndrome (2.7%), and aneurysm formation (1.3%).

The primary failure rate of AVFs in this study was 10.7%, with all failures occurring in the BCAV group. Literature suggests that RCAVs typically have higher failure rates, particularly in elderly patients.²⁰ However, in our study, RCAVs demonstrated a 100% immediate success rate, reinforcing their role as the preferred option when feasible.

The overall AVF success rate (89.3%) in this study is comparable to reported success rates of 87.9%, confirming the effectiveness of native AVFs for hemodialysis.²¹

Limitations of the Study

The study duration was limited to one year, restricting long-term follow-up on AVF patency and late complications. Patients were referred back to nephrologists postoperatively, making it difficult to track AVF outcomes over extended periods. Despite being a prospective study, data on comorbidities (diabetes mellitus and hypertension) were unavailable, limiting comprehensive risk factor analysis.

Conclusions

Brachiocephalic AVFs were the most frequently created vascular access for ESRD patients, with an immediate success rate of 89.3%. However, radiocephalic AVFs demonstrated superior outcomes, with a 100% success rate and no complications, making them the preferred choice when suitable veins are available. These findings emphasize the importance of careful patient selection and adherence to best practices in AVF creation to optimize patient outcomes. All complications occurred in BCAVFs, highlighting the need for careful patient

selection and surgical planning. Older patients and pediatric cases successfully underwent AVF creation, demonstrating that age alone should not be a contraindication for surgery. The economic burden of ESRD is significant, with most patients lacking stable income, emphasizing the need for improved financial support systems.

Recommendations

Multidisciplinary collaboration between vascular surgeons and nephrologists is essential for long-term follow-up of AVF outcomes, particularly regarding late patency rates and long-term complications. Radiocephalic AVFs should be prioritized whenever feasible due to their superior long-term outcomes and lower complication rates. Further prospective studies with extended follow-up periods are required to evaluate AVF patency, complications, and risk factors comprehensively. Increased awareness and adherence to international guidelines on vascular access placement can help optimize AVF success rates and patient outcomes.

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Authors' Contributions

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Concept and Design: 1

Data Collection and Analysis: 1, 2

Responsibility for Statistical Analysis: 1

Writing the Article: 1

Critical Review: 1, 2

Final Approval of the Article: 1, 2

Each author believes that the manuscript represents honest work and certifies that the article is original, is not under consideration by any other journal, and has not been previously published. Availability of Data and Material: The corresponding author is prompt to supply datasets generated during and/or analyzed during the current study on wise request.

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