



Transposed Brachiobasilic Arteriovenous Fistula versus Prosthetic Arteriovenous Graft: A Comparative Cohort Analysis of Primary Patency and Complication Profiles in Hemodialysis Patients

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Abstract

Background: Establishing durable vascular access is a critical determinant of outcomes in patients receiving hemodialysis. When the superficial cephalic vein is anatomically unsuitable or exhausted, clinicians must choose among alternative access strategies, primarily a transposed brachiobasilic arteriovenous fistula (tBBAVF) or a prosthetic arteriovenous graft (AVG).

Objectives: This study compared short-term primary patency and complication profiles, particularly hemodialysis access-induced distal ischemia (steal syndrome), between a tBBAVF and a prosthetic AVG.

Methods: This retrospective cohort study evaluated adult hemodialysis patients who underwent tBBAVF placement ($n = 30$) or upper-extremity expanded polytetrafluoroethylene (ePTFE) AVG placement ($n = 30$) at a tertiary academic center between March 2020 and March 2024. Because of constraints in synthetic graft availability, a census sampling strategy was used ($N = 60$). The primary endpoint was 6-month primary patency. Univariate cross-tabulations using chi-square tests and independent-samples t tests were performed to analyze determinants of patency and postoperative outcomes.

Results: The total cohort ($n = 60$; mean age, 63.0 ± 12.9 years) had high baseline rates of hypertension (76.7%, $n = 46$) and diabetes mellitus (50.0%, $n = 30$). At 6 months, overall primary patency was maintained in 51.7% of patients ($n = 31$). Chi-square analysis showed no statistically significant difference in 6-month primary patency between the tBBAVF group (56.7%, $n = 17$) and the AVG group (46.7%, $n = 14$) ($\chi^2 = 0.601$, $P = 0.438$). Male sex was a significant univariate predictor of higher 6-month primary patency ($\chi^2 = 5.380$, $P = 0.020$). The overall incidence of steal syndrome was 46.7% ($n = 28$) and was not significantly associated with vascular access type ($\chi^2 = 0.268$, $P = 0.605$). However, diabetes mellitus was significantly associated with a higher incidence of steal syndrome ($\chi^2 = 4.290$, $P = 0.038$).

Conclusions: Short-term (6-month) primary patency did not differ significantly between the tBBAVF and prosthetic AVG cohorts. However, the wide confidence intervals reflect substantial uncertainty due to the limited sample size; therefore, the nonsignificant difference should not be interpreted as definitive clinical equivalence or non-inferiority. Access selection should remain individualized. The high incidence of steal syndrome, particularly among patients with diabetes, supports the need for rigorous preoperative arterial assessment.

Keywords: Transposed Brachiobasilic Arteriovenous Fistula (tBBAVF), Arteriovenous Graft (AVG), Hemodialysis, Primary Patency, Steal Syndrome, Diabetes Mellitus

1. Background

The global burden of end-stage renal disease (ESRD) continues to rise, necessitating reliable and sustainable

renal replacement therapies (1). For the vast majority of patients undergoing maintenance hemodialysis, establishing durable vascular access is a critical determinant of clinical outcomes, quality of life, and

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overall survival (2). The 2019 Kidney Disease Outcomes Quality Initiative (KDOQI) guideline moved away from a universal "fistula-first" paradigm toward individualized vascular-access planning based on the patient's end-stage kidney disease Life-Plan (3). Autogenous arteriovenous fistulas may nevertheless offer advantages over prosthetic alternatives, including superior long-term patency and fewer infectious complications in appropriate patients (4). However, achieving optimal autogenous access is often challenged by the progressive depletion of suitable superficial veins, driven by advanced patient age, peripheral vascular disease, diabetes mellitus, and repeated prior venipunctures (5). When the preferred upper-extremity cephalic vein is anatomically unsuitable, inadequate in caliber, or previously exhausted, vascular surgeons must navigate a complex decision-making process (6). The two primary therapeutic strategies under these circumstances are the transposed brachio basilic arteriovenous fistula (tBBAVF) and the insertion of a prosthetic arteriovenous graft (AVG) (7).

The tBBAVF uses the deep basilic vein, requiring extensive surgical mobilization and superficial transposition to enable repetitive cannulation (8). Although this autogenous configuration benefits from inherent endothelial resistance to infection and intimal hyperplasia, it is limited by a technically demanding procedure, often requiring a two-stage approach, and a prolonged maturation period that may necessitate extended central venous catheter (CVC) dependence (9). Conversely, prosthetic AVGs are typically constructed from expanded polytetrafluoroethylene (ePTFE), offering immediate technical feasibility and a predictable anatomical configuration (10). In addition, they provide the distinct advantage of early or immediate cannulation, thereby minimizing exposure to central venous catheters (11). Nevertheless, AVGs have historically been plagued by a high propensity for neointimal hyperplasia at the venous anastomosis, leading to frequent thrombotic occlusions, accelerated stenosis, and substantially higher infection rates requiring surgical revision or explantation (12).

2. Objectives

Despite extensive investigation, the comparative performance of tBBAVF and AVG remains a matter of debate in the vascular access literature. Variations in patient characteristics, institutional expertise, and clinical selection criteria complicate comparisons. This study evaluated and compared 6-month primary patency, cumulative time to patency loss, and postoperative complications, with particular attention to hemodialysis access-induced distal ischemia (steal syndrome), in a

contemporary cohort of hemodialysis patients with exhausted superficial cephalic veins.

3. Methods

3.1. Study Design and Setting

This retrospective observational cohort study was conducted at Imam Khomeini Hospital, a tertiary academic center affiliated with Urmia University of Medical Sciences, Urmia, Iran, between March 2020 and March 2024. The research protocol was reviewed and approved by the Ethics Committee of Urmia University of Medical Sciences (IR.UMSU.HIMAM.REC.1403.017). Patient confidentiality was maintained throughout the study. Owing to the retrospective design, the requirement for direct informed consent was waived. All patient data were de-identified and handled in accordance with the Declaration of Helsinki.

3.2. Study Population

The target population comprised adult hemodialysis patients referred to the vascular surgery service for vascular access creation. The study population included patients who underwent either tBBAVF creation or placement of an upper-extremity prosthetic AVG at Imam Khomeini Hospital between March 2020 and March 2024.

3.2.1. Inclusion Criteria

- 1) Confirmed anatomical unsuitability or exhaustion of the cephalic vein on preoperative duplex ultrasonography.
- 2) Underwent either tBBAVF creation or placement of an arm prosthetic AVG using ePTFE.

3.2.2. Exclusion Criteria

- 1) Concomitant central venous stenosis or occlusion ipsilateral to the planned access site.
- 2) Prior complex vascular access reconstruction or proximal bypass in the target extremity.
- 3) Requirement for an early-cannulation-specific graft to standardize the comparison with standard ePTFE.
- 4) Follow-up of less than 6 months, unless the access failed or the patient died before this endpoint.

3.3. Preoperative Evaluation

All patients underwent comprehensive preoperative vein mapping using high-resolution duplex ultrasonography. The minimum anatomical criteria for tBBAVF creation were a continuous basilic vein diameter > 3.0 mm under a tourniquet and an ipsilateral brachial artery diameter $\geq$ 2.0 mm without severe continuous

calcification. In the AVG group ($n = 30$), treatment allocation was based on prespecified clinical and anatomical constraints:

1) Anatomical unsuitability: $n = 21$ (70.0%) had inadequate basilic vein caliber (< 3.0 mm) or localized venous sclerosis.

2) Clinical urgency/catheter avoidance: $n = 6$ (20.0%) required rapid access cannulation to avoid prolonged central venous catheter (CVC) dependence because of active catheter-related bloodstream infection or poor tolerance.

3) Limited life expectancy/medical frailty: $n = 3$ (10.0%) had severe systemic comorbidities for which a multistage surgical maturation process was clinically contraindicated.

3.4. Surgical Techniques

All procedures were performed under regional anesthesia (brachial plexus block) or local anesthesia with intravenous sedation by board-certified vascular surgeons.

tBBAVF: Depending on vein caliber, tBBAVF was performed as either a single-stage or two-stage procedure. In the two-stage approach, the first stage involved an end-to-side anastomosis of the native basilic vein to the brachial artery. After 4 - 6 weeks of maturation to allow venous dilation, second-stage superficialization was performed. The arterialized vein was mobilized through a longitudinal or skip-incision approach, transposed anteriorly into a subcutaneous tunnel, and superficialized to permit safe repetitive cannulation.

Prosthetic AVG: ePTFE grafts (standard 6-mm or 4 - 7-mm tapered configurations) were implanted. The specific configuration (straight arm, loop forearm, or loop arm) was determined by individual anatomy and available outflow veins, typically the deep brachial or axillary veins. Anastomoses were constructed using standard running nonabsorbable monofilament sutures.

3.5. Postoperative Care and Surveillance

Postoperative access surveillance included clinical examinations for thrill, bruit, and edema at 2 weeks, 6 weeks, and every 3 months thereafter. For tBBAVF, initial cannulation was permitted only after clinical clearance by the surgical team. Clinical maturation was typically defined as a vein diameter > 6 mm, depth < 6 mm from the skin surface, and access flow > 600 mL/min, consistent with the KDOQI "Rule of 6s." Standard ePTFE AVGs were typically cleared for cannulation 14 - 21 days postoperatively.

3.6. Outcome Assessment and Blinding

Because of the retrospective observational cohort design, formal prospective blinding of outcome assessment was not performed. Primary outcome and complication data were extracted through systematic medical record review of standardized clinical evaluations, routine hemodialysis nursing access reports, and duplex ultrasonography studies performed by board-certified vascular surgeons.

3.7. Endpoints and Definitions

Clinical endpoints were defined according to the recommended Society for Vascular Surgery (SVS) reporting standards.

Primary patency failure: Primary patency was defined as the interval, in months, from access creation until any intervention intended to maintain or re-establish patency, access thrombosis, or final follow-up (up to 6 months). Patency failure was defined as any of the following prespecified events: 1) total acute or subacute access thrombosis confirmed by absent pulse/thrill and duplex ultrasonography; 2) hemodynamically significant stenosis ($> 50\%$ luminal narrowing on duplex ultrasonography associated with a peak systolic velocity ratio > 2.0 or clinical dysfunction during hemodialysis); 3) inability to achieve successful two-needle cannulation for hemodialysis (maturation failure); or 4) any endovascular or surgical intervention performed to maintain flow.

Secondary patency: The interval from access creation until access abandonment, surgical ligation, or replacement, including time supported by endovascular or surgical interventions such as thrombectomy or angioplasty.

Maturation failure: Inability to successfully use the autogenous access for two-needle hemodialysis for at least two-thirds of dialysis sessions over a 30-day period.

Complications: Recorded postoperative complications included surgical-site infection, graft/fistula infection requiring explantation or systemic antibiotics, steal syndrome (hemodialysis access-induced distal ischemia), hematoma, and seroma.

Censoring framework: Patients who maintained a functioning, unintervened vascular access at the end of the 6-month study period were censored at 6 months. Patients who died with a patent access or were lost to follow-up before 6 months without access failure were censored at the date of their last documented clinical contact. Access failure or the requirement for surgical/endovascular intervention was treated as an event.

Steal syndrome/HAlDI diagnosis and grading: Hemodialysis access-induced distal ischemia (HAlDI), clinically manifesting as steal syndrome, was diagnosed

based on clinical symptoms (distal extremity coldness, pain, paresthesia, or diminished distal pulses during hemodialysis) and confirmed by duplex ultrasonography demonstrating retrograde flow in the distal native artery or dampening of distal arterial signals. Cases were graded using the SVS clinical severity scale: Grade 1 (mild), pale or cool limb or mild paresthesia during dialysis without pain, managed conservatively; Grade 2 (moderate), intermittent pain during hemodialysis or exercise, managed conservatively or monitored closely; and Grade 3 (severe), rest pain or continuous tissue ischemia/neurologic deficit requiring surgical or endovascular intervention.

3.8. Sample Size and Sampling Method

A census sampling strategy was used. All medical records of adult hemodialysis patients who underwent either tBBAVF or ePTFE prosthetic AVG placement at the study center between March 2020 and March 2024 were reviewed. The final cohort included 60 patients, with 30 patients in each group.

3.9. Sample Size and Precision Framing

Because the retrospective sample size was fixed, statistical inference was presented using effect estimates with 95% confidence intervals to convey precision and sample uncertainty, rather than formal post hoc power calculations. Confidence intervals were used to assess whether clinically meaningful differences could be ruled out.

3.10. Statistical Analysis

Data extraction and statistical analyses were performed using SPSS version 21 (IBM Corp., Armonk, NY). Continuous variables were summarized using measures of central tendency and dispersion, including means, medians, and standard deviations (SDs). Categorical variables were analyzed using chi-square (χ^2) or Fisher exact tests, as appropriate, and are presented as frequencies and percentages (n,%).

Cumulative 6-month primary patency over time was estimated using the Kaplan-Meier method. Differences in patency distributions between the tBBAVF and AVG groups were evaluated using the log-rank (Mantel-Cox) test. Discrete 6-month patency rates were also examined using chi-square cross-tabulations to calculate risk differences (RDs) and odds ratios (ORs) with 95% confidence intervals (CIs). All tests were 2-tailed, and $P < 0.05$ was considered statistically significant.

To evaluate potential confounding, baseline comparability between the tBBAVF and AVG groups was assessed across clinical, demographic, and anatomical

parameters. Given the constrained sample size ($N = 60$) and event counts (29 patency losses and 28 cases of steal syndrome), full multivariable logistic regression was limited by the events-per-variable (EPV) rule. Applying standard EPV guidance ($\geq 10 - 15$ events per candidate predictor) restricted the candidate pool to a maximum of 2 predictors to reduce overfitting, coefficient instability, and inflated type I error.

Accordingly, parsimonious multivariable logistic regression models were constructed for 1) primary patency, adjusted for access type (tBBAVF vs. AVG) and sex; and 2) steal syndrome, adjusted for access type and diabetes mellitus. Unadjusted cross-tabulations, crude ORs (cORs), adjusted ORs (aORs), and 95% CIs were reported.

4. Results

4.1. Baseline Characteristics

A total of 60 patients with end-stage renal disease who underwent vascular access creation were evaluated, with 30 patients in each group. Baseline demographic and clinical characteristics were similar between the groups.

The overall mean age was 63.0 ± 12.9 years, with no significant difference between the tBBAVF (61.5 ± 13.4 years) and AVG (64.6 ± 12.4 years) groups ($t = -0.951$, $P = 0.345$). Men comprised 60.0% ($n = 36$) of the cohort, with similar distributions between access types (56.7% in the tBBAVF group vs. 63.3% in the AVG group, $P = 0.598$). Baseline rates of hypertension (73.3% vs. 80.0%, $P = 0.543$) and diabetes mellitus (46.7% vs. 53.3%, $P = 0.605$) also did not differ significantly between the groups. Baseline characteristics are presented in [Table 1](#).

The mean ipsilateral brachial artery diameter was 3.2 ± 0.5 mm in the tBBAVF group and 3.0 ± 0.6 mm in the AVG group ($t = 1.402$, $P = 0.166$). Preoperative CVC duration was similar between the groups (45.1 ± 19.8 days vs. 39.9 ± 16.4 days, $t = 1.109$, $P = 0.272$), as was the prevalence of peripheral arterial disease and/or vascular calcification (33.3% vs. 40.0%, $\chi^2 = 0.289$, $P = 0.591$) ([Table 1](#)).

4.2. Primary Patency at 6 Months

Primary patency at 6 months was maintained in 51.7% ($n = 31$) of the cohort. In the unadjusted analysis, 6-month primary patency was observed in 56.7% ($n = 17$) of the tBBAVF group and 46.7% ($n = 14$) of the AVG group, corresponding to an absolute RD of +10.0% (95% CI, -15.1% to +35.1%; cOR = 1.49; 95% CI, 0.54 to 4.10; $P = 0.438$).

A parsimonious multivariable logistic regression model was constructed because 29 patients experienced primary patency failure, limiting the number of predictors under

Table 1. Group Comparison of Baseline Demographic and Clinical Characteristics ^a

Variables	Total Cohort (n = 60)	tBBAVF Group (n = 30)	AVG Group (n = 30)	Test Statistic	P Value
Mean age (y)	63.0 ± 12.9	61.5 ± 13.4	64.6 ± 12.4	t = -0.951	0.345
Gender				$\chi^2 = 0.278$	0.598
Male	36 (60.0)	17 (56.7)	19 (63.3)		
Female	24 (40.0)	13 (43.3)	11 (36.7)		
Comorbidities					
Hypertension	46 (76.7)	22 (73.3)	24 (80.0)	$\chi^2 = 0.370$	0.543
Diabetes mellitus	30 (50.0)	14 (46.7)	16 (53.3)	$\chi^2 = 0.267$	0.605
Brachial artery caliber (mm)	3.1 ± 0.6	3.2 ± 0.5	3.0 ± 0.6	t = 1.402	0.166
Preoperative CVC duration (d)	42.5 ± 18.3	45.1 ± 19.8	39.9 ± 16.4	t = 1.109	0.272
Peripheral arterial disease/calcification	22 (36.7)	10 (33.3)	12 (40.0)	$\chi^2 = 0.289$	0.591

^a Values are expressed as mean ± SD or No. (%). Continuous variables were analyzed using independent-samples t tests; categorical variables were analyzed using chi-square tests. Abbreviations: SD, standard deviation; tBBAVF, transposed brachiobasilic arteriovenous fistula; AVG, arteriovenous graft; CVC, central venous catheter.

EPV considerations. After adjustment for access type and sex, access type was not independently associated with 6-month primary patency (aOR = 1.54; 95% CI, 0.54 to 4.39; $P = 0.418$). The corresponding absolute RD was +10.0% (95% CI, -15.1% to +35.1%). The wide confidence intervals for both effect estimates indicate substantial imprecision due to the sample size and do not establish clinical equivalence or non-inferiority.

Male sex was independently associated with 6-month primary patency. Men had a 6-month primary patency rate of 63.9% ($n = 23/36$), compared with 33.3% ($n = 8/24$) in women, corresponding to an absolute RD of +30.6% (95% CI, +5.2% to +55.9%). After adjustment for access type, male sex remained associated with higher primary patency (aOR = 3.62; 95% CI, 1.20 to 10.92; $P = 0.022$). Hypertension ($P = 0.451$) and diabetes mellitus ($P = 0.438$) were not significantly associated with 6-month primary patency (Table 2).

4.3. Postoperative Steal Syndrome

Hemodialysis access-induced distal ischemia (HAIDI), clinically manifesting as steal syndrome, was diagnosed clinically and confirmed by duplex ultrasonography in 28 patients, for an overall incidence of 46.7%. Most cases were mild: Grade 1 accounted for 64.3% of steal cases ($n = 18/28$; 30.0% of the total cohort), Grade 2 for 25.0% ($n = 7/28$; 11.7% of the total cohort), and Grade 3 for 10.7% ($n = 3/28$; 5.0% of the total cohort). The inclusion of mild Grade 1 presentations contributed to the overall diagnostic rate of 46.7%.

Steal syndrome was not significantly associated with vascular access type in the univariate analysis (43.3% in the tBBAVF group vs. 50.0% in the AVG group; RD = -6.7%; 95%

CI, -31.8% to +18.4%; cOR = 0.76; 95% CI, 0.27 to 2.12; $P = 0.605$) or after adjustment for diabetes mellitus (aOR = 0.71; 95% CI, 0.24 to 2.08; $P = 0.531$). Sex ($P = 0.139$) and hypertension ($P = 0.348$) were also not significantly associated with steal syndrome.

Diabetes mellitus was independently associated with steal syndrome. Patients with diabetes had a steal-syndrome rate of 60.0% ($n = 18/30$), compared with 33.3% ($n = 10/30$) among patients without diabetes, corresponding to an absolute RD of +26.7% (95% CI, +2.5% to +50.8%; cOR = 3.00; 95% CI, 1.05 to 8.58; $P = 0.038$). After adjustment for vascular access type, diabetes mellitus remained associated with higher odds of distal ischemia (aOR = 3.12; 95% CI, 1.07 to 9.08; $P = 0.037$) (Table 3).

4.4. Time-to-Event Primary Patency Outcomes

Primary patency was evaluated over a 6-month observational period. Kaplan-Meier analysis showed cumulative 6-month primary patency rates of 56.7% ($n = 17$ remaining at risk) in the tBBAVF group and 46.7% ($n = 14$ remaining at risk) in the AVG group.

The log-rank test showed no statistically significant difference in time to patency loss between the tBBAVF and AVG groups (log-rank $\chi^2 = 0.601$, $P = 0.438$). Cumulative patency rates at 1, 3, and 6 months were 83.3% ($n = 25$ at risk), 70.0% ($n = 21$ at risk), and 56.7% ($n = 17$ at risk), respectively, for the tBBAVF group, compared with 76.7% ($n = 23$ at risk), 63.3% ($n = 19$ at risk), and 46.7% ($n = 14$ at risk), respectively, for the AVG group. No patients were lost to follow-up or died with a patent access before 6 months; therefore, all non-event censoring occurred at the 6-month endpoint.

Chi-square analysis of 6-month patency yielded an RD of +10.0% (95% CI, -15.1% to +35.1%) and an OR of 1.49 (95% CI,

Table 2. Factors Associated with Primary Patency at 6 Months ^a

Variables	Total (n = 60)	Patency < 6 Mo (n = 29)	Patency ≥ 6 Mo (n = 31)	Risk Difference	Crude	Adjusted ^b	Test Statistic	P Value
Vascular access type				RD: +10.0% (-15.1% to +35.1%); OR: 1.49 (0.54 to 4.10)	1.49 (0.54 to 4.10)	1.54 (0.54 to 4.39)	$\chi^2 = 0.601$	0.438
AVG	30 (100)	16 (53.3)	14 (46.7)					
tBBAVF	30 (100)	13 (43.3)	17 (56.7)					
Gender				RD: +30.6% (+5.2% to +55.9%); OR: 3.54 (1.20 to 10.45)	3.54 (1.20 to 10.45)	3.62 (1.20 to 10.92)	$\chi^2 = 5.38$	0.020
Male	36 (100)	13 (36.1)	23 (63.9)					
Female	24 (100)	16 (66.7)	8 (33.3)					
Hypertension				RD: +11.4% (-18.2% to +41.1%); OR: 1.59 (0.47 to 5.33)	1.59 (0.47 to 5.33)		$\chi^2 = 0.568$	0.451
Yes	46 (100)	21 (45.7)	25 (54.3)					
No	14 (100)	8 (57.1)	6 (42.9)					
Diabetes mellitus				RD: +10.0% (-15.1% to +35.1%); OR: 1.49 (0.54 to 4.10)	1.49 (0.54 to 4.10)		$\chi^2 = 0.601$	0.438
Yes	30 (100)	13 (43.3)	17 (56.7)					
No	30 (100)	16 (53.3)	14 (46.7)					

^a Values are expressed as No. (%) or OR (95% CI). Abbreviations: Statistical comparisons were performed using Pearson chi-square tests. RD, absolute risk difference; OR, odds ratio; CI, confidence interval; AVG, arteriovenous graft; tBBAVF, transposed brachioabasilic arteriovenous fistula.

^b Adjusted model included access type and sex.

Table 3. Factors Associated with Postoperative Steal Syndrome ^a

Variables	Total Cohort (n = 60)	Steal Syndrome Present (n = 28)	Steal Syndrome Absent (n = 32)	Risk Difference	Crude	Adjusted ^b	Test Statistic	P Value
Vascular access type				RD: -6.7% (-31.8% to +18.4%); OR: 0.76 (0.27 to 2.12)	0.76 (0.27 to 2.12)	0.71 (0.24 to 2.08)	$\chi^2 = 0.268$	0.605
tBBAVF	30 (100)	13 (43.3)	17 (56.7)					
AVG	30 (100)	15 (50.0)	15 (50.0)					
Gender				RD: +19.4% (-6.1% to +45.0%); OR: 2.20 (0.77 to 6.31)	2.20 (0.77 to 6.31)	—	$\chi^2 = 2.19$	0.139
Male	36 (100)	14 (38.9)	22 (61.1)					
Female	24 (100)	14 (58.3)	10 (41.7)					
Hypertension				RD: +14.3% (-15.1% to +43.7%); OR: 1.80 (0.52 to 6.25)	—	—	$\chi^2 = 0.880$	0.348
Yes	46 (100)	23 (50.0)	23 (50.0)					
No	14 (100)	5 (35.7)	9 (64.3)					
Diabetes mellitus				RD: +26.7% (+2.5% to +50.8%); OR: 3.00 (1.05 to 8.58)	3.00 (1.05 to 8.58)	3.12 (1.07 to 9.08)	$\chi^2 = 4.29$	0.038
Yes	30 (100)	18 (60.0)	12 (40.0)					
No	30 (100)	10 (33.3)	20 (66.7)					

^a Values are expressed as No. (%) or OR (95% CI). Abbreviations: Statistical comparisons were performed using Pearson chi-square tests. RD, absolute risk difference; OR, odds ratio; CI, confidence interval; tBBAVF, transposed brachioabasilic arteriovenous fistula; AVG, arteriovenous graft.

^b Adjusted model included access type and diabetes mellitus.

0.54 to 4.10; P = 0.438). Given the limited sample size and wide confidence intervals, these nonsignificant findings do not provide definitive evidence of equivalence.

5. Discussion

The optimization of vascular access in hemodialysis patients with exhausted superficial cephalic veins remains a formidable clinical challenge (13). This study aimed to evaluate the comparative efficacy and safety profiles of tBBAVF and prosthetic AVG.

The similar short-term primary patency observed for tBBAVF and prosthetic AVG may reflect different mechanisms of early failure. Autogenous fistulas depend on successful venous remodeling to achieve clinical viability (14), whereas AVGs avoid the maturation phase but are susceptible to thrombosis and neointimal hyperplasia related to compliance mismatch and the absence of an endothelialized conduit (15, 16). Patency-loss patterns in arteriovenous fistulas may also differ between early and later follow-up periods (17). These distinct mechanisms and time courses underscore that the present 6-month findings should not be extrapolated to long-term access durability.

Rather than establishing a definitive comparative treatment effect, our findings describe observational associations between conduit choice and short-term primary patency in real-world clinical practice. In nonrandomized practice, vascular-access selection is subject to confounding by indication because patients receiving prosthetic AVGs may have compromised native vasculature or greater clinical urgency (6, 18). Therefore, the lack of a statistically significant difference in 6-month primary patency between tBBAVF (56.7%) and AVG (46.7%) should not be interpreted as proven therapeutic equivalence or non-inferiority. The direct comparative findings are consistent with those reported by Lu et al. (19). Eldesouky and Fayed (20) compared brachiocephalic with proximal radiocephalic fistulas and provide related context on outcomes across autogenous fistula configurations rather than a direct tBBAVF-versus-AVG comparison. Initial conduit selection should remain individualized.

Male sex was associated with higher early primary patency in this cohort. Lee et al. (21) also reported sex-based disparities in vascular-access outcomes. Women may have smaller baseline arterial and venous calibers (22), which can impair access maturation and limit hemodynamic flow, and biological mechanisms have also been proposed as contributors to sex differences in fistula failure (23). These observations support careful preoperative vascular assessment, while recognizing that the present sex-associated estimate is based on a small cohort.

A notable safety finding was the high overall incidence of steal syndrome (46.7%). Proximal access sites carry a greater risk of HAIDI because of larger anastomotic diameters and higher flow volumes (24). The elevated rate in this study may also reflect the burden of peripheral arterial disease (25) and the broad diagnostic threshold, which included mild, transient Grade 1 cases. Severe Grade 3 steal requiring surgical correction occurred in 5.0% of the total cohort. *Diabetes mellitus* was independently associated with steal syndrome. This finding is biologically plausible

given the microvascular and macrovascular complications of diabetes (26, 27), and impaired distal compensatory vasodilation can contribute to symptomatic ischemia after high-flow access creation (28). Careful preoperative assessment of distal arterial runoff is therefore particularly important in patients with diabetes who require proximal access.

An analysis of additional demographic variables revealed that age and hypertension did not significantly influence primary patency or the incidence of complications. This finding is consistent with that of Roşu et al. (29), who reported that these factors lack a direct impact on primary patency and complication rates. While some other studies suggest that advanced age or poorly controlled hypertension may increase postoperative complications (30), such discrepancies are typically attributable to sample size limitations and variations in postoperative management protocols. Consequently, age and hypertension are not sole determinants of vascular access success and must be evaluated in conjunction with broader clinical and anatomical parameters (31).

Furthermore, the type of vascular access used in the current study did not significantly affect complication rates, indicating comparable performance between fistulas and grafts. This aligns with the findings of Lu et al. (19), who observed no significant differences in primary patency or complication rates between the two modalities. Although some literature reports disparate outcomes, these variations likely arise from differences in surgical technique, operator experience, or specific patient comorbidities (32, 33). Therefore, to ensure long-term viability, the selection of vascular access should be based on individualized patient characteristics and anatomical suitability rather than on the inherent nature of the conduit alone.

Synthesizing the overall results, the primary patency rates of brachiocephalic fistulas and arm grafts did not differ significantly, a conclusion supported by international evidence. Notably, gender and diabetes emerged as significant clinical determinants affecting primary patency and complication rates, whereas age, hypertension, and access type demonstrated no substantial impact. By delineating these associations, this study informs clinical decision-making for establishing hemodialysis access. It underscores that meticulous management, routine surveillance, and the selection of appropriate surgical techniques can optimize long-term access survival and mitigate complication risks (26). An evaluation of the broader literature indicates that minor observational discrepancies generally stem from variations in measurement methodologies, sample sizes, follow-up intervals, and baseline clinical profiles (32). Ultimately,

vascular access planning must remain patient-centered, guided by comprehensive clinical assessments rather than dictated exclusively by conduit type or isolated demographic traits.

5.1. Study Limitations

Several limitations should be considered. First, the single-center retrospective design introduces selection bias and confounding by indication. Because treatment allocation was nonrandomized, patients receiving prosthetic AVGs represented a systematically different cohort, including patients with smaller basilic veins, greater clinical urgency, or higher frailty. Thus, the tBBAVF and AVG groups were not fully exchangeable, potentially obscuring intrinsic differences in conduit performance. Second, the cohort size (N = 60) was constrained by census sampling and real-world graft-availability restrictions related to international trade sanctions. The resulting statistical imprecision, reflected in wide 95% confidence intervals, precluded propensity-score matching and extensive multivariable adjustment. Third, the 6-month follow-up was insufficient to characterize long-term access trajectories, which may diverge over 1 - 2 years. Finally, the retrospective dataset was limited to primary patency and early postoperative steal syndrome. Secondary patency, intervention burden, maturation time, cannulation metrics, and quantitative dialysis-adequacy indices (Kt/V) were not recorded. Prospective multicenter studies with longer follow-up and formal non-inferiority designs are needed to evaluate long-term access durability.

5.2. Conclusions

In hemodialysis patients with exhausted superficial veins, short-term (6-month) primary patency did not significantly differ between tBBAVF and prosthetic AVG. However, because of the small sample size and limited statistical precision, definitive clinical equivalence or non-inferiority cannot be concluded. Access selection should remain individualized. The high incidence of steal syndrome, particularly among patients with diabetes, supports rigorous preoperative arterial assessment. Prospective multicenter studies with formal non-inferiority designs and extended follow-up are needed to establish long-term access performance.

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Footnotes

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