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Comparative outcomes of autologous great saphenous vein versus polytetrafluoroethylene arteriovenous grafts in hemodialysis patients with exhausted upper-extremity vascular access

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Article

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Abstract

Background

For hemodialysis patients with exhausted upper-extremity vascular access, autologous great saphenous vein (GSV) serves as an important reconstructive alternative when upper-arm native fistulas cannot be created. Real-world comparative evidence between GSV and polytetrafluoroethylene (PTFE) grafts in this high-risk subgroup remains scarce. This study compared graft patency and complications between GSV and PTFE conduits using propensity-score-matched cohort data.

Methods

This dual-center retrospective study enrolled maintenance hemodialysis patients with exhausted upper-extremity access. Patients were 1:1 propensity-score matched into GSV (n = 30) and PTFE (n = 30) groups, balanced for key clinical covariates (SMD < 0.1). All participants completed 24-month follow-up. Primary endpoints were 24-month primary and secondary graft patency; secondary outcomes included thrombosis, infection, stenosis and interventional events. Kaplan-Meier and appropriate statistical tests were applied. The study was retrospectively registered (ChiCTR2500112130, 12 March 2025).

Results

Baseline features were well balanced after PSM. The GSV group achieved superior 24-month primary patency (86.7% vs. 63.3%, P < 0.05), with numerically better secondary patency (90.0% vs. 76.7%). GSV exhibited lower rates of thrombosis and access-site infection. Competing mortality was documented during follow-up. Given limited primary-patency failure events, multivariable prognostic modelling was not performed.

Conclusions

For hemodialysis patients with exhausted upper-extremity vascular access, autologous GSV graft yields better 24-month primary patency and favourable safety compared with PTFE prosthetic grafts. Larger multicenter investigations are needed to validate these observations.

1. Introduction

Autologous great saphenous vein (GSV) transposition is a valuable reconstructive alternative for hemodialysis patients for whom all upper-extremity vascular access options have failed, when native upper-arm arteriovenous fistulas cannot be created or salvaged [1]. Compared with synthetic graft materials, autologous venous conduits possess theoretical advantages including superior

biocompatibility, reduced infection risk, and favourable structural durability [2]. Nevertheless, real-world comparative data between GSV and PTFE grafts specifically in this heavily pre-treated patient population remain sparse [3]. Existing vascular-access literature focuses predominantly on conventional upper-extremity fistulas or prosthetic grafts, with few dedicated comparative series for GSV transposition for dialysis access [4].

Important clinical uncertainties persist: magnitude of long-term patency benefit for GSV versus PTFE, rates of major access-related complications, and patient-level factors associated with graft outcomes [4]. Sample size constraints frequently hamper research in this patient subgroup, as patients with completely exhausted upper-limb access constitute a small fraction of the overall dialysis population [5]. The present study used propensity-score matching to balance baseline risk factors between GSV-treated and PTFE-treated patients, with the primary objective of comparing 24-month graft patency and complication outcomes [6]. We did not construct a prognostic nomogram in view of limited outcome events, as cautioned by prognostic-model methodological standards.

2. Materials and Methods

2.1 Study population and design

This dual-center retrospective observational cohort included maintenance hemodialysis patients from Yingtan 184 Hospital and the Second Affiliated Hospital of Nanchang University. The source unmatched cohort, study time frame, and patient flow are provided in supplementary materials. Patients represented 8%-12% of local prevalent dialysis patients, reflecting the low prevalence of patients with fully exhausted upper-extremity access. Consecutive eligible subjects were enrolled applying standardized inclusion/exclusion criteria to reduce selection bias. Participants were 1:1 propensity-score matched (PSM) into GSV graft (n = 30) and PTFE prosthetic graft (n = 30) groups. Matched covariates included age, sex, diabetes, hypertension, coronary artery disease, dialysis vintage, preoperative central venous stenosis, prior access failure, and serum albumin. Covariate balance was defined as standardized mean difference (SMD) < 0.1; SMD values for all matched variables are presented in Supplementary Table S1. Sensitivity analyses were performed to evaluate residual confounding.

Inclusion criteria

(1) Confirmed end-stage kidney disease (ESKD) receiving long-term maintenance hemodialysis. (2) All upper-extremity vascular access options were exhausted, necessitating thigh/lower-extremity arteriovenous graft creation. (3) Complete baseline data and 24-month postoperative follow-up data or documented death during follow-up were available.

Exclusion criteria

(1) Active systemic or access-site infection at time of surgery. (2) NYHA class III-IV severe heart failure. (3) Predicted survival < 2 years at the time of graft placement. (4) Missing key baseline or outcome variables.

Survivorship-related considerations: Requirement for complete follow-up information includes capturing all-cause mortality events occurring within the 24-month window; patients who died during follow-up were retained in analyses and counted as competing-risk events, rather than excluded. Competing mortality was formally documented for all participants.

Allocation to graft type: Selection for GSV versus PTFE graft was determined pre-operatively by vascular-access multidisciplinary team, incorporating venous duplex vein mapping, measured GSV diameter, quality of the saphenous vein, patient comorbidity burden, and anatomical conditions; these clinical decisions represent inherent selection bias that cannot be fully eliminated by propensity-score matching alone.

2.2 Surgical Procedures

A unified vascular surgical team performed all operations under standardized protocols. For the GSV group: preoperative venous duplex ultrasound vein mapping was routinely performed; minimally invasive great saphenous vein harvest was completed, with minimum acceptable GSV internal diameter ≥ 3.5 mm. The vein was implanted as a subcutaneous lower-extremity interposition arteriovenous graft, with standardized inflow and outflow vessel selection. The control group received standard 6-mm expanded PTFE lower-extremity subcutaneous interposition grafts. Uniform perioperative antiplatelet and anticoagulation medication protocols and surgical techniques were applied across both cohorts.

2.3 Follow-up and endpoint definitions

Post-operative surveillance combined clinical examination and duplex ultrasound imaging, scheduled at 1, 3, 6, 9, 12, 18, and 24 months after graft creation.

Primary patency: Time from graft creation to first salvage intervention (thrombolysis, angioplasty, surgical revision) or permanent graft abandonment. Patients who died prior to graft-failure events were treated as competing risk observations.

Secondary patency: Total graft survival accounting for all rescue procedures before definitive graft removal.

Secondary outcomes: Graft thrombosis, access-site infection, intimal stenosis, number of additional interventional requirements.

2.4 Data collection

Electronic medical records were extracted for baseline variables: demographics (age, sex, BMI kg/m²), comorbidities (diabetes, hypertension), laboratory markers (hemoglobin, serum albumin g/L), ESKD etiology, intraoperative surgical parameters, and all-cause mortality events during follow-up.

2.5 Statistical Analysis

All statistical analyses were performed using SPSS 26.0 and R 4.3.1. Normality was assessed via the Shapiro-Wilk test. Continuous variables were presented as mean ± standard deviation or median (interquartile range) and compared by independent t-test or Mann-Whitney U test. Categorical data were summarized as frequencies (%) and analyzed via χ^2 or Fisher's exact test where appropriate. Kaplan-Meier survival curves were generated for primary and secondary patency; between-group comparisons were performed using log-rank test. Competing mortality events were tabulated. Cox regression model building and prognostic nomogram construction were not undertaken given the limited number of primary-patency failure events in this cohort. Two-tailed $P < 0.05$ indicated statistical significance.

3. Results

3.1 Baseline Characteristics

Table 1 summarizes baseline demographics and clinical indices after PSM. Full SMD values for all nine matched covariates are reported in supplementary Table S1. No intergroup differences were observed for all reported baseline covariates (all $P > 0.05$), confirming acceptable covariate balance after matching between GSV and PTFE cohorts.

Table 1
Baseline demographic and clinical characteristics of the study population after 1:1 propensity-score matching

Characteristic	GSV group (n = 30)	PTFE group (n = 30)	*P* value
Age, years, mean ± SD	62.5 ± 10.2	61.8 ± 9.7	0.79
Male, n (%)	18 (60.0)	17 (56.7)	0.79
BMI, kg/m², mean ± SD	23.6 ± 2.8	23.2 ± 3.1	0.61
Diabetes mellitus, n (%)	16 (53.3)	15 (50.0)	0.79
Hypertension, n (%)	27 (90.0)	26 (86.7)	0.69
Haemoglobin, g/L, mean ± SD	101.5 ± 12.3	99.8 ± 11.7	0.58
Serum albumin, g/L, mean ± SD	36.2 ± 4.1	35.7 ± 3.9	0.64

Note: Baseline demographic and clinical characteristics of patients after 1:1 propensity score matching. Continuous variables are presented as mean ± standard deviation; categorical variables as n (%). Intergroup comparisons used independent t-test for continuous data and χ^2 test for categorical data. All $P > 0.05$ indicated balanced baseline covariates post-matching. Abbreviations: BMI, body mass index; GSV, great saphenous vein; PTFE, polytetrafluoroethylene. Supplementary Table S1 reports standardized mean difference values for all nine propensity-score-matched covariates; Supplementary Table S2 summarises graft-related adverse events; Supplementary Table S3 contains exploratory univariate Cox analyses.

3.2 Primary, secondary patency and secondary clinical outcomes

Over the 24-month observation period, there were 15 primary-patency failure events: four events within the GSV group and eleven events within the PTFE group. All-cause death occurred in 7 patients across the full cohort during follow-up. Kaplan-Meier survival analysis showed that the GSV group demonstrated superior primary patency at 24-month (86.7% vs 63.3%, log-rank $P = 0.026$; Fig. 1). Observed 24-month secondary patency was 90.0% (GSV) versus 76.7% (PTFE).

Absolute counts of secondary adverse events: graft thrombosis occurred in 2/30 GSV patients versus 8/30 PTFE patients; access-site infection was seen in 1/30 GSV patients versus 6/30 PTFE patients. The GSV group experienced fewer total access-related re-interventions. Full tabulation of adverse clinical outcomes is provided in supplementary Table S2.

3.3 Exploratory univariate associations

Given the limited number of primary-patency failure events, multivariate Cox proportional-hazards modelling to identify independent predictors was considered statistically under-powered and was not performed. Univariate unadjusted associations between individual baseline variables and graft failure are presented only as exploratory descriptive data in Supplementary Table S3; these results should be interpreted with great caution and are not used to build any predictive tool.

4. Discussion

Consistent with several prior vascular-access studies evaluating lower-extremity arteriovenous grafts for dialysis patients with exhausted upper-limb access, autologous GSV grafts achieved better 24-month primary patency compared with PTFE synthetic grafts [7]. This clinical advantage is plausibly explained by improved endothelialization properties, reduced local inflammatory response, and the intrinsic biocompatibility of native venous tissue relative to synthetic prosthetic material [8]. In our matched cohort, GSV was also associated with numerically lower rates of thrombosis and access-site infection, which carry major clinical consequences for hemodialysis patients[9].

Serum albumin was collected as part of baseline characterization. An inverse crude univariate association between hypoalbuminemia and graft-failure risk was observed in unadjusted exploratory analysis; however this finding must be treated as hypothesis-generating only. We put forward three potential mechanistic explanations for this counter-intuitive observation: attenuation of uremic intimal inflammatory signalling in states of severe malnutrition, potential endothelial protective effects from intravenous albumin infusions administered during hemodialysis, and competing mortality bias, whereby hypoalbuminemic patients may die before graft-failure events manifest during follow-up [10]. Because of sample-size limitations, we emphasize that this observation cannot be regarded as causal or clinically

actionable. Large multicenter prospective datasets are required to clarify relationships between nutritional biomarkers, inflammation, and saphenous-vein graft remodelling [11].

This study has multiple important limitations. First, this is a dual-center retrospective investigation with modest sample size (n = 60). Even after propensity-score matching, residual confounding cannot be fully eliminated; unmeasured variables include medication adherence, completeness of preoperative vein-mapping findings, and peripheral arterial disease burden. Second, graft-type assignment was determined by clinical teams and depended on vein quality and anatomical features, introducing selection bias which cannot be fully removed by PSM. Third, only descriptive between-group comparisons are reported; formal prognostic prediction-model development was not performed due to the limited number of outcome events, consistent with methodological recommendations for clinical prediction research. Fourth, findings are derived from a Chinese dual-center cohort; external generalizability to other populations requires further validation.

Despite these constraints, this descriptive comparative series adds real-world evidence for GSV graft performance in a high-burden subgroup of hemodialysis patients for whom conventional upper-extremity dialysis access pathways are no longer feasible.

5. Conclusions

Within this propensity-score-matched dual-center retrospective cohort of hemodialysis patients with depleted upper-extremity vascular access, autologous GSV grafts demonstrated superior 24-month primary patency and lower absolute complication burden compared with PTFE prosthetic grafts. Observations regarding secondary patency and nutritional-marker associations remain hypothesis-generating. Larger multicenter datasets are needed to confirm these outcomes and enable future development of robust risk-stratification tools for this challenging patient population.

Abbreviations

BMI
Body mass index
CI
Confidence interval
ESKD
End-stage kidney disease
GSV
Great saphenous vein
PSM
Propensity score matching
PTFE
Polytetrafluoroethylene

SMD
Standardized mean difference

Declarations

Ethics approval and consent to participate

This study obtained ethical approval from the Ethics Committee of China RongTong Medical Healthcare Group-Yingtan 184 Hospital (Reference No.:184YY-2025-LL-040). The Ethics Committee of The Second Affiliated Hospital of Nanchang University has reviewed and granted research filing approval for participating in this dual-center retrospective study without assigning an independent separate ethical approval number. Written informed consent was obtained from all participants in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable. No individual participant-level data are published in this manuscript.

Author Contribution

XX: conceptualization, formal statistical analysis, software programming, original draft writing, revision.FH: data curation, statistical analysis, original draft writing.JW: study design, methodology, resource collection.RZ, SG, YL, L D: patient data acquisition and clinical resource support.GX: funding acquisition, project supervision, manuscript critical revision.Xiaojie Xie and Fengmei Huang share equal first authorship. All authors read and approved the final manuscript.

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None.

Data Availability

The datasets analysed during the current study are available within the published manuscript and supplementary tables. Raw anonymized clinical datasets are available from the corresponding author Gaosi Xu upon reasonable formal written request.

References

1. Conte, M. S. et al. Impact of Bypass Conduit and Early Technical Failure on Revascularization for Chronic Limb-Threatening Ischemia. *Circ. Cardiovasc. Interv*. **18** (3), e014716 (2025).
2. Zizhou, R., Khoshmanesh, K., Wang, X. & Houshyar, S. Fabrication of Nanocomposites with High Elasticity and Strength for the Load-Bearing Layer of Small-Diameter Vascular Grafts. *ACS Appl. Mater. Interfaces*. **15** (29), 35411–35421 (2023).
3. Mikami, T., Dashwood, M. R., Kawaharada, N. & Furuhashi, M. An Obligatory Role of Perivascular Adipose Tissue in Improved Saphenous Vein Graft Patency in Coronary Artery Bypass Grafting. *Circ. J.* **88** (6), 845–852 (2024).
4. Lok, C. E., Huber, T. S., Orchanian-Cheff, A. & Rajan, D. K. Arteriovenous Access for Hemodialysis: A Review. *JAMA* **331** (15), 1307–1317 (2024).
5. McIntyre, C. W. & Jain, A. Dialysis and cognitive impairment. *Nat. Rev. Nephrol.* **21** (8), 553–564 (2025).
6. Bellomo, T. R. et al. Endovascular Therapy, Open Surgical Bypass, and Conduit Types for Index Treatment of Claudication. *JAMA Netw. Open.* **8** (10), e2533352 (2025).
7. Cherkaoui, R. et al. (eds) 's Choice - Outcomes of Cold Stored Saphenous Vein Allografts for Haemodialysis Vascular Access. Eur J Vasc Endovasc Surg. ;68(3):397–404. (2024).
8. Yi, B. et al. Step-wise CAG@PLys@PDA-Cu2 + modification on micropatterned nanofibers for programmed endothelial healing. *Bioact Mater.* **25**:657–676 .
9. Sun, H. et al. Endothelium-inspired coating for hemodialysis needle: Heparin-modulated sustained NO release for synergistic anti-thrombotic and anti-infective effects. *J. Control Release* **393**:114756 .
10. Visser, M. Undernutrition in community-dwelling older adults: prevalence, causes and consequences. *Proc. Nutr. Soc.* :1–7 .
11. Stephenson, S. S., Kravchenko, G., Gawron-Skarbek, A., Kostka, T. & Sołtysik, B. K. Association between immuno-nutritional biomarkers and mortality in hospitalized geriatric population. *Front. Immunol.* **16**:1692551 .

Figures

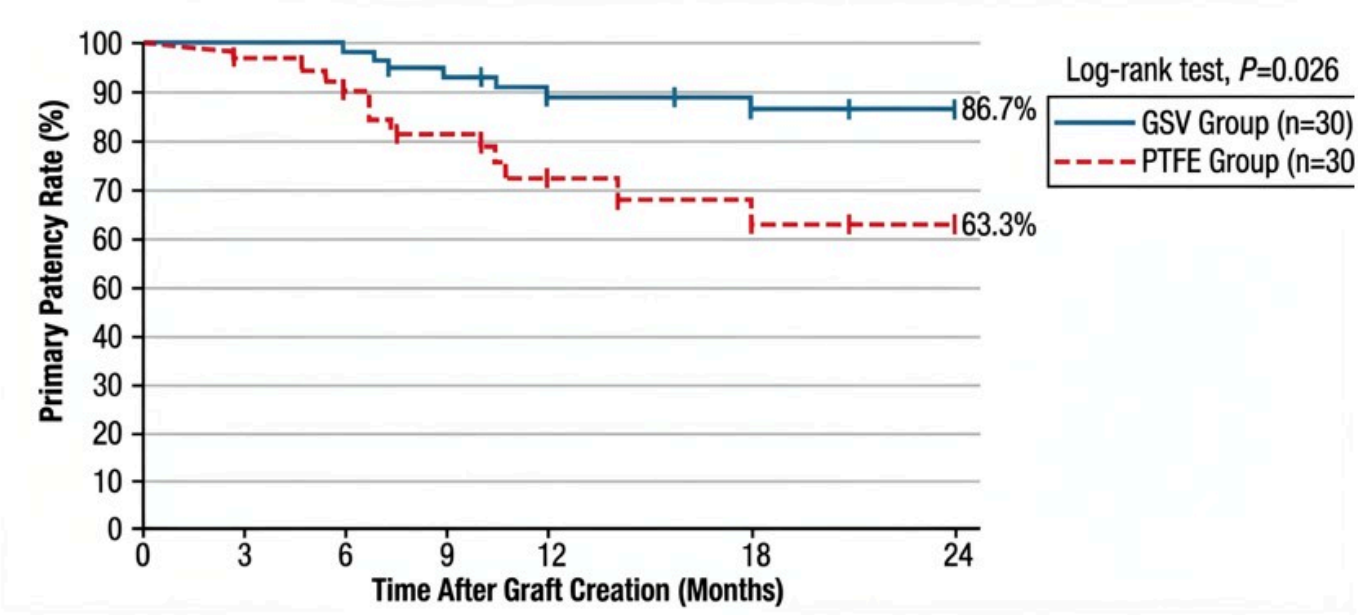


Figure 1

Kaplan-Meier curve comparing 24-month primary graft patency between GSV and PTFE groups.

Note: Kaplan-Meier curves for graft patency after graft creation in the GSV group and PTFE group. The 24-month patency rate was 86.7% in the GSV group and 63.3% in the PTFE group. Log-rank test showed a significant difference between the two groups (P = 0.026). Vertical tick marks represent censored cases. GSV, great saphenous vein; PTFE, polytetrafluoroethylene.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementarymaterials.docx