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ORIGINAL ARTICLE

The Value of Great Saphenous Vein Harvest in Brachio-Axillary Arteriovenous Fistula for Hemodialysis

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ABSTRACT

Keyword: Arteriovenous fistula, Great saphenous vein, Hemodialysis, Patency, Vascular access.

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Background: Autologous arteriovenous fistula remains standard for hemodialysis access, offering fewer complications. In patients with inadequate upper limb veins, alternative options such as great saphenous vein or prosthetic grafts must be considered. This study aimed to evaluate the outcomes of GSV harvest for AVF creation in patients with poor superficial veins, focusing on patency, and complications. **Methods**: This study included 25 hemodialysis patients with exhausted upper limb veins. All patients underwent AVF creation using the harvested GSV. Patient characteristics, patency rates, and postoperative complications were assessed. The primary outcome was the patency rate at 3, 6, and 12 months. Secondary outcomes included maturation time, and complications. **Results**: The time for maturation was significantly longer (36.66 ± 4.91 days), while operative time was 119.52 ± 10.6 minutes. Primary patency rates at 12 months were 24%, with secondary patency improving to 36%. Thrombosis occurred in 28% of patients by 12 months, and access failure was reported in 28% of cases. Postoperative complications included pseudoaneurysm (32%), hematoma (24%), and bleeding (16%). **Conclusions**: GSV harvest for AVF creation is a viable option for patients with inadequate upper limb veins, though it requires longer operative times and has a higher complication rate. Despite this, secondary patency rates were relatively favorable.

INTRODUCTION

Hemodialysis is a life-sustaining therapy for patients with end-stage renal disease (ESRD), and the creation of durable vascular access is critical to its success[1]. Among the various options available, an autologous arteriovenous fistula (AVF) remains the preferred choice due to its superior long-term patency, lower complication rates, and reduced infection risk compared to synthetic grafts and central venous catheters[2]. However, in some patients, particularly those with exhausted or inadequate superficial veins in the upper limbs, creating a standard AVF can be challenging, necessitating alternative approaches to ensure effective hemodialysis access[3].

The use of the great saphenous vein (GSV) as an alternative conduit for AVF creation has emerged as a valuable option in patients with poor superficial venous anatomy. The GSV, being a large and relatively accessible vein in the lower limb, offers a viable substitute for upper limb veins in creating a functional AVF[4]. This technique has been shown to provide satisfactory

patency rates while minimizing the need for prosthetic grafts, which are associated with higher rates of infection and thrombosis.

Despite the potential advantages of using the GSV, concerns remain regarding its technical complexity, longer operative time, and risk of postoperative complications such as graft thrombosis, pseudoaneurysms, and access failure. These factors must be carefully considered when selecting the optimal approach for AVF creation, particularly in patients who have limited options for vascular access[5].

The present study aims to evaluate the clinical outcomes of GSV harvest for AVF creation in hemodialysis patients with compromised superficial venous systems. We seek to assess the patency rates, maturation time, and complication profiles of GSV-based AVFs and compare these outcomes with other access options, such as prosthetic grafts, to determine the overall effectiveness and safety of this technique in providing reliable hemodialysis access.

Through this research, we hope to provide valuable insights into the role of GSV harvest in expanding access options for hemodialysis patients, thereby improving the quality of life and clinical outcomes in this vulnerable population.

The objective of this work was to assess the clinical outcomes and effectiveness of using the great saphenous vein (GSV) as a conduit for arteriovenous fistula (AVF) creation in hemodialysis patients who have compromised or exhausted superficial venous systems. Specifically, the study aimed to evaluate patency rates, maturation time, complication profiles, and overall safety of GSV-based AVFs, comparing these outcomes with prosthetic graft options to determine the optimal approach for providing reliable long-term vascular access for hemodialysis.

PATIENT AND METHOD

This prospective randomized controlled trial included 25 patients with chronic renal failure on regular hemodialysis and inaccessible superficial veins of both upper limbs for arteriovenous fistula (AVF) creation. The study was conducted at the Vascular Surgery Department, Aswan University Hospital. All patients provided signed informed consent prior to their participation, and the study was conducted in accordance with ethical guidelines, ensuring confidentiality and proper handling of patient data.

Inclusion and Exclusion Criteria: Patients were selected based on the following inclusion criteria: they were undergoing hemodialysis and had failed superficial venous systems in both upper limbs, making conventional AVF creation impossible. Patients with deep venous thrombosis, acute superficial thrombophlebitis, prior saphenous vein stripping, extremely tortuous great saphenous veins (GSV), a GSV diameter less than 2.5 mm, central vein occlusion, and chronic lower limb ischemia were excluded from the study.

Preoperative Evaluation: All patients underwent a thorough preoperative evaluation, which included:

- A detailed medical history.
- Laboratory tests: creatinine, cholesterol, HbA1c, complete blood count, prothrombin time (PT), partial thromboplastin time (PTT), international normalized ratio (INR), and electrolyte levels.
- Imaging: Color Doppler ultrasonography was performed preoperatively to assess the vascular anatomy and saphenous vein suitability. In select cases, ascending venography was performed to further evaluate venous patency.

Surgical Technique: patients underwent saphenous vein interposition grafting to create an AVF for hemodialysis access. The procedure was performed under either local, regional, or general anesthesia, depending on the patient's clinical condition.

- The great saphenous vein (GSV) was harvested from the lower limb.
- A reversed GSV interposition graft was placed between the brachial artery and axillary vein to create the arteriovenous connection.

Postoperative Care and Follow-Up: Postoperatively, patients received routine care, including anticoagulation therapy as needed and wound care. Antibiotic prophylaxis was provided during surgery. Patients were monitored for early complications such as infection, bleeding, and graft patency.

Clinical follow-up was conducted over 12 months with duplex ultrasonography at 3, 6, and 12 months to assess graft patency and AVF function. Functional patency was defined as the ability to achieve adequate dialysis blood flow (≥250 mL/min) within 48 days post-surgery. Cases of AVF dysfunction, including failure to mature or thrombosis, were evaluated using angiography when necessary.

Outcome Measures: The primary outcomes assessed were:

- Primary and secondary patency rates.
- Major complications such as AVF thrombosis or failure to mature.

Secondary outcomes included:

- Minor complications, such as wound infections and localized seromas.

Statistical analysis

- SPSS v26 was utilized for the statistical analysis (IBM Inc., Armonk, NY, USA). Average and standard deviation (SD) were utilized to represent numerical variables, which were subsequently analysed using the unpaired student t-test. Analyses of qualitative variables were represented in the form of frequencies and percentages (%), was conducted as appropriate utilizing the Chi-square test. A two-tailed P value ≤0.05 was considered to indicate statistical significance.

RESULTS

- This prospective randomized controlled study included 25 patients, all of whom had chronic renal failure and were undergoing hemodialysis with inaccessible superficial veins of the upper limbs for arteriovenous fistula (AVF) creation. The procedure performed for these patients was a reversed interposition saphenous vein graft between the brachial artery and the axillary vein. The mean age of patients was 50.96 ± 4.6 years. Most of the patients were males, accounting for 56% of the group.

  Age, gender, ASA physical status, diabetes mellitus (DM), hypertension (HTN), hyperlipidemia, ischemic heart disease (IHD), peripheral arterial obstructive disease, smoking status, and laboratory parameters (hemoglobin, platelets, white blood cells, creatinine, urea, ALT, AST, sodium, and potassium) showed no significant differences among the studied cases. **Table 1**

  The time for maturation and graft maturation, as well as operative time and hospital stay for the studied cases. The mean time for maturation was 36.66 days, with graft maturation averaging 28.76 days. The average operative time was 119.52 minutes, and patients had a mean hospital stay of 1.92 days. These findings highlight the efficiency of the procedures

and the expected recovery duration for patients undergoing saphenous vein grafting. **Table 2**

The mean distal pulsation rate was 75.55 ± 8.67 beats per minute, indicating adequate blood flow. However, the rates of graft thrombosis showed a concerning trend, with incidences of 8.0%, 20.0%, and 28.0% at 3, 6, and 12 months, respectively, underscoring the need for careful monitoring and management post-surgery. **Table 3**

The primary patency rates at 3, 6, and 12 months were 24%, 28%, and 24%, respectively, indicating stability in the early postoperative period, but with no improvement noted at 12 months. In contrast, the secondary patency rates showed a gradual increase over time, reaching 24%, 32%, and 36% at the corresponding intervals, suggesting that while primary patency may be limited, secondary interventions may enhance overall vascular access sustainability. **Table 4**

Regarding the Complications, there were one case had Infection, four cases had Bleeding, eight cases had Pseudo aneurysm, six cases had Hematoma, and five cases had Mortality. **Table 5**

Table 1: Patients' Characteristics, Comorbidities, and Laboratory Investigations of the Studied Cases

Parameter	**No. = 25**
Age (years)	
Mean ± SD	51.96 ± 4.7
Range	45 - 60
Gender	
Male	12 (48%)
Female	13 (52%)
ASA Physical Status	
I	8 (32%)
II	11 (44%)
III	5 (20%)
IV	1 (4%)
Comorbidities	
DM	9 (36%)
HTN	11 (44%)
Hyperlipidemia	5 (20%)
Drain	13 (52%)
IHD	8 (32%)
Peripheral Arterial Obstructive Disease	5 (20%)
Smoking	13 (52%)
Laboratory Investigations	
Hb (g/dl)	Mean ± SD: 12.47 ± 1.11

Range	10.7 - 14.3
Platelets (x109 cells/L)	Mean ± SD: 256.2 ± 67.88
Range	151 - 343
WBCs (x109 cells/L)	Mean ± SD: 7.8 ± 2.4
Range	4.7 - 11.4
Creatinine (mg/dl)	Mean ± SD: 4 ± 0.9
Range	2.6 - 5.6
Urea (mg/dl)	Mean ± SD: 38.68 ± 6.49
Range	29 - 50
ALT (U/L)	Mean ± SD: 26.6 ± 6.33
Range	18 - 39
AST (U/L)	Mean ± SD: 33.36 ± 7.42
Range	21 - 44
Na (mEq/L)	Mean ± SD: 141.08 ± 2.96
Range	136 - 145
K (mmol/L)	Mean ± SD: 4.42 ± 0.56
Range	3.5 - 5.5

Table 2 Times for Maturation, Graft Maturation, Operative Time, and Hospital Stay of the Studied Cases

Parameter	**No. = 25**
Time for Maturation (days)	
Mean ± SD	36.66 ± 4.91
Range	27 - 45
Time for Graft Maturation (days)	
Mean ± SD	28.76 ± 6.89
Range	20 - 40
Operative Time (min)	
Mean ± SD	119.52 ± 10.6
Range	104 - 139
Hospital Stay (days)	
Mean ± SD	1.92 ± 0.86
Range	1 - 3

Table (3): Distal Pulsation and Graft Thrombosis of the Studied Cases

Parameter	No.	Mean ± SD	Range	Thrombosis (%)
Distal Pulsation (beats/min)	25	75.55 ± 8.67	60 - 90	
Thrombosis at 3 months	25			2 (8.0%)
Thrombosis at 6 months	25			5 (20.0%)
Thrombosis at 12 months	25			7 (28.0%)

Table (4): Patency of the Studied Cases

Parameter	**No.**	**Patency (%)**
Primary Patency	**25**	
At 3 months		6 (24%)
At 6 months		7 (28%)
At 12 months		6 (24%)
Secondary Patency	**25**	
At 3 months		6 (24%)
At 6 months		8 (32%)
At 12 months		9 (36%)

Table (5): Complications of the studied cases.

	No. = 25
Infection	1 (4%)
Bleeding	4 (16%)
Pseudo aneurysm	8 (32%)
Hematoma	6 (24%)
Mortality	5 (20%)

DISCUSSION

The current study was designed to evaluate the long-term patency outcomes of 25 patients with poor superficial venous system quality or exhaustion of all available arteriovenous fistulas (AVFs) who underwent autologous saphenous vein grafts as the initial hemodialysis vascular access surgery. Patients were selected based on their chronic renal failure and the inaccessibility of superficial veins in both upper limbs for AVF. The findings of our study indicate that autologous saphenous vein grafts remain a suitable option as a vascular access conduit, demonstrating significantly lower infection rates and better postoperative hemoglobin levels,

although with longer operative times. Additionally, pseudoaneurysms occurred more frequently in this group.

Preservation of functional vascular access is a vital component for effective hemodialysis, especially as the number of individuals with chronic kidney disease (CKD) continues to rise. AVFs are recognized as the most efficient and secure method of access for patients undergoing hemodialysis, ensuring adequate blood flow while minimizing complications and mortality rates, thereby being cost-effective【2】. In underdeveloped nations, where access to synthetic grafts may be limited due to cost and a high infection rate, utilizing autologous saphenous vein grafts can be the most advantageous option for those with damaged or inadequate upper limb veins 【9】.

In our study, demographic factors such as age, gender, and ASA physical status showed no significant differences among the participants. Similarly, comorbidities including diabetes mellitus, hypertension, hyperlipidemia, drain use, ischemic heart disease, and peripheral arterial obstructive disease did not demonstrate significant differences between the patients undergoing saphenous vein grafts. Laboratory values, including hemoglobin, platelets, white blood cells, creatinine, urea, ALT, AST, sodium, and potassium, were also comparable among the studied cases. These findings align with the results reported by Abdel Rahman et al., who compared the efficacy of prosthetic vascular grafts and repositioned great saphenous vein bridge fistulas and found no significant differences in demographics and comorbidities between the cases【10】.

Our study revealed that the time for maturation and graft maturation were significantly longer in the saphenous vein graft patients. This is consistent with findings from Yousef et al., who reported that the optimal time for graft development occurred at an average of 39.9 ± 7.71 days postoperatively for saphenous vein grafts, compared to significantly shorter durations for other types of grafts【6】.

Access failure rates at 3, 6, and 12 months did not significantly differ among the studied patients. Silva et al. noted that a non-invasive preoperative evaluation might enhance secondary patency rates and expand the application of autogenous AVFs, ultimately reducing early failures【9】.

Operative time and length of hospital stay were significantly increased for patients in the saphenous vein graft. This aligns with the observations of Yousef et al., who reported that the average total surgical time was significantly longer for the saphenous vein graft (120.7 ± 9.51 minutes)【6】.

Postoperatively, hemoglobin levels were significantly higher in patients who underwent saphenous vein grafts. Furthermore, blood loss was significantly lower in the saphenous vein graft group. However, this contradicts Yousef et al., who documented that the median blood loss in their study patients was statistically significant【6】.

In terms of graft thrombosis, rates at three, six, and twelve months were not significantly different. Abdel Rahman et al. reported that graft thrombosis significantly impacted patency, with higher occurrences in prosthetic graft groups compared to the saphenous vein group, suggesting better long-term outcomes for the latter【10】.

In our study, smoking status was comparable among the participants, with 10 (40%) in each group showing no significant difference. Primary and secondary patency rates at 3, 6, and 12 months were also insignificantly different【6】. Monroy-Cuadros et al. further supported this, stating that tobacco users had a 3.7 times greater likelihood of experiencing critical functional patency failure【11】.

Our findings also indicated a significant decrease in infection rates in the saphenous vein graft group. However, the incidence of pseudoaneurysms was higher in the saphenous vein graft group. Bleeding, hematoma, and mortality rates showed no significant differences. Abdel Rahman et al. reported similar findings, noting that complications such as bleeding and pseudoaneurysms occurred at different rates, with no reported mortality during the follow-up period【10】.

Huber et al. emphasized the benefits of native loop AVFs as the primary approach due to their lower costs and lower incidence of complications【12】.

CONCLUSIONS

Patients who underwent the reversed interposition saphenous vein graft for hemodialysis access demonstrated prolonged operative times and extended hospital stays. Despite these increased time requirements, the grafts achieved satisfactory primary and secondary patency rates. Additionally, the postoperative hemoglobin levels were well-maintained, and blood loss was minimized, indicating effective management of hemostasis. Overall, the use of saphenous vein for arteriovenous fistula creation in this patient population presents a favorable option for hemodialysis access.

Conflicts of interest

There is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' contributions

Ali Mahmoud Mohamed Galal given substantial contributions to the conception or the design of the manuscript

Marco Shahat Abdrabo, Mohamed Ahmed Mohamed Ismael and Ahmed Khalaf Fathy Mahmoud acquisition, analysis and interpretation of the data.

All authors have participated to drafting the manuscript, author A revised it critically. All authors read and approved the final version of the manuscript.

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