OUTCOME OF VASCULAR ACCESS SURGERY FOR HEMODIALYSIS IN END-STAGE RENAL DISEASE

Tieu Chi Duc*, Tran Huu Phuoc**

ABSTRACT

Background: Chronic kidney disease is a significant global health burden due to its high incidence and the risk of progression to end-stage renal disease (ESRD), cardiovascular disease, and premature death. Hemodialysis is a common kidney replacement therapy used for patients with ESRD with vascular access surgery crucial. **Objectives:** This study aims to evaluate the early and mid-term results of vascular access surgery. **Subjects and Methods:** A retrospective, descriptive case series study. At the TVS Department, Gia Dinh People's Hospital, from January 2020 to December 2022 were included. **Results:** The study involved 160 patients. Among the 125 patients had been follow up postoperation. The average age was 57 ± 14.5 years. Hypertension in 96.7%, diabetes in 44.7%, heart failure in 18.7%, and 10.6% had other comorbidities. Early results showed access occlusion in 18/141 cases (12.8%). Complications included 3.5% seroma and 2.1% distal limb ischemia syndrome. 77.3% with mature fistulas. Mid-term results showed 3.7% fistula occlusion during hemodialysis, and only 1 case experienced distal limb ischemia syndrome requiring ligation. 6.4% need to support from balloon dilation or branch ligation. **Conclusion:** Atrioveneous fistula for hemodialysis in ESRD patients has shown good results based on individual clinical examination and preoperative vascular ultrasound.

Keywords: *chronic kidney disease, end-stage renal disease, hemodialysis, vascular access, arteriovenous fistula.*

I. INTRODUCTION

Chronic kidney disease (CKD) is a major global health burden due to its high incidence and risk of progression to end-stage renal disease (ESRD), cardiovascular disease, and premature death[1]. The Global Burden of Disease Study 2013 estimated 956,200 deaths worldwide related to CKD in 2013, a 134.6% increase from 1990. CKD was ranked as the 19th leading cause of death in 2013. It is estimated that around 1.9 million ESRD patients received kidney replacement therapy in 2010[2-4]. Kidney replacement therapy for ESRD patients includes hemodialysis, peritoneal dialysis, and kidney transplantation, with hemodialysis being the most commonly used method[5]. At Gia Dinh People's Hospital, the number of ESRD patients undergoing hemodialysis is relatively high, making vascular access surgery crucial. However, there has been no study on the effectiveness of this surgery at the hospital or its ability to support optimal long-term patient treatment. We conducted this study to evaluate the effectiveness of this method.

II. METHODS

Study Design

Retrospective.

Target Population

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All ESRD patients who underwent vascular access surgery at the Department of Thoracic and Vascular Surgery, Gia Dinh People's Hospital, from January 2020 to December 2022.

Inclusion Criteria

Patients diagnosed with end-stage renal disease who required hemodialysis and underwent vascular access surgery at the Department of Thoracic and Vascular Surgery.

Exclusion Criteria

Incomplete data for research. Patients who were not followed up or lost contact after surgery.

III. RESULTS

The study examined 160 ESRD patients who underwent surgery from January 2020 to December 2022 at the Department of Thoracic and Vascular Surgery, Gia Dinh People's Hospital. Of these, 35 patients lost contact, were not followed up after surgery, or died during the study period. Among the 125 patients in the study group, 75 were female (60%). The average age was 57 ± 14.5 years (range 21 to 82). Most patients were undergoing kidney replacement therapy with 92 patients (73.6%), while the remaining 33 patients (26.4%) were operated on to prepare for hemodialysis as soon as kidney replacement therapy was indicated.

Table 1. ***Patient Characteristics in the Study Group***

Characteristic	n = 125
Age (years)	57 ± 14.5 (21 – 82)
Female	75 (60%)
BMI (kg/m²)	22.7 ± 3.5 (16.7 – 35.2)
eGFR	8.4 ± 4 (2.6 – 27.2)
Comorbidities	
Hypertension	96.7%
Diabetes	44.7%
Heart Failure	18.7%
Other	10.6%

Vascular access surgery was performed on 125 patients with 151 arteriovenous fistulas (AVFs) in the upper extremities (22 patients had surgery at 2 different sites, and 2 patients had surgery at 3 different sites). All patients in the study group were examined with Doppler ultrasound of the upper extremity arteries and veins before surgery to evaluate and locate suitable sites for the fistula. We usually preferred to use the non-dominant arm, but in some cases with unsuitable blood vessels, we chose the dominant arm[6].

Table 2. ***Characteristics of Arteriovenous Fistulas***

Fistula Type	n = 151
Radial artery – Cephalic vein	
Left	100 (66.2%)
Right	63 (63%)
Radial artery Diameter (mm)	2.4 ± 0.6 (1.2 – 5)
Cephalic vein Diameter (mm)	2.7 ± 0.8 (1.1 – 5.5)
Brachial artery – Cephalic vein	
Left	43 (28.5%)
Right	28 (65.1%)

Fistula Type	n = 151
Brachial artery Diameter (mm)	4 ± 1 (2.4 – 6.5)
Cephalic vein Diameter (mm)	3 ± 1.4 (1.2 – 9)
Brachial artery – Basilic vein	
Left	8 (5.3%)
Right	6 (75%)
Brachial artery Diameter (mm)	4 ± 1.3 (2.5 – 6.2)
Basilic vein Diameter (mm)	3 ± 1.6 (1.4 – 6)

Most patients were discharged on the first postoperative day, except those who needed regular hemodialysis. Postoperative complications were monitored within 72 hours, including bleeding in 8 cases (5.3%), seroma in 7 cases (4.6%), with no immediate post-surgical ischemic syndrome or wound infections. Fistulas that occluded within 72 hours post-surgery were considered surgical failures, with 10/151 cases (6.6%).

Early results were defined as the period from postoperative to 3 months post-vascular access creation[7]. During this period, fistula occlusion was considered a surgical failure, occurring in 18/141 cases (12.8%). Complications during this time included seroma in 5 cases (3.5%) and ischemic syndrome in 3 cases (2.1%). The maturity of arteriovenous fistulas was assessed by Doppler ultrasound 6–8 weeks post-surgery, with successful surgeries defined as those ready for hemodialysis. There were 112/141 cases (77.3%) of mature fistulas used for hemodialysis within 3 months.

Table 3. ***Follow-up Results***

	Immediate Occlusion	Early Occlusion	Maturity	Late Maturity
Postoperative	10/151 (6.6%)			
Early Results		18/141 (12.8%)	112/141 (77.3%)	
Mid-term Results			108/141 (76.6%)	9/141 (6.4%)

Mid-term results were defined as the period from 3 months to 6 months post-vascular access creation[7]. For mature and used fistulas, the ability to maintain functionality without complications was assessed. Out of 112 cases, 108 cases (96.4%) were usable with 4 cases (3.7%) having occlusions and 1 case (0.9%) with ischemic syndrome requiring ligation.

IV. DISCUSSION

To date, the method of kidney replacement therapy through hemodialysis has provided a life-saving option for patients with chronic kidney disease in general, and end-stage renal disease in particular. It allows them to survive for many years with a good quality of life[5]. The improvement in the longevity of patients undergoing hemodialysis has created a demand for effective vascular access surgery. The ideal vascular access should provide sufficient flow rate to sustain the hemodialysis process, be easily accessible for catheter placement, be cost-effective, and have long-term durability with minimal complications[8].

In 1966, Brescia and Cimino introduced the forearm arteriovenous fistula (AVF) surgical method, but the authors only selected relatively young patients for their

study[9]. Currently, the NKF-DOQI clinical practice guidelines recommend creating an autologous AVF for most patients beginning hemodialysis[5]. The main limitation of AVF is that it is not immediately available, as the newly formed fistula requires time to mature with reduced resistance and increased flow rate. An AVF is considered immature if it cannot be used for hemodialysis within three months of its creation. NKF-DOQI guidelines recommend the "6's rule" to determine the maturity of the fistula, including a flow rate >600 ml/min, a skin depth <6 mm, and a fistula diameter >6 mm. A mature AVF allows for a flow rate of at least 300-400 ml/min[8,10].

In clinical practice, the common vascular access surgery is the radial-cephalic arteriovenous fistula (RCAVF) at the wrist[11]. However, the primary failure rate of RCAVF can be as high as 30-60%[12,13]. Additionally, creating a distal AVF reduces the risk of developing distal limb ischemia syndrome and associated cardiac complications while maintaining the potential for creating a proximal AVF[10,14,15]. The distal forearm is the most common site for the radial-cephalic AVF[16]. In our study, 100 cases (66.2%) underwent RCAVF surgery, with 90 cases being successful (90%). Brachiocephalic and brachiobasilic AVFs were reserved for patients who had previous RCAVF failures or in cases where suitable vascular sites for wrist AVF creation were not available. The average diameter of arteries and veins in the successful group was slightly larger than in the other group, but the difference was not statistically significant. The American Institute of Ultrasound in Medicine (AIUM) Practice guidelines indicate that an artery diameter <2 mm and a vein diameter <2.5 mm are associated with higher failure rates[17]. Gupta et al.'s study also demonstrated that a vein diameter <2 mm is associated with a significantly higher rate of immaturity (p <0.001)[18]. In our study, the average artery diameter was about 2.4 mm, so the impact of artery diameters <2 mm could not be assessed.

Initial failure rates reported in medical literature range from 20% to 60%[19,20], which aligns with our overall failure rate of 22.6%. Clinical evaluation combined with preoperative ultrasound assessment contributed to the overall success rate in our study. Factors such as age and longevity, gender, comorbidities, vascular status, and type of anastomosis may not individually predict outcomes but should be considered when selecting the appropriate access site according to the patient's life plan[10,12,21].

V. CONCLUSION

Vascular access surgery for hemodialysis in ESRD patients at Gia Dinh People's Hospital demonstrates a high success rate with acceptable outcomes. Despite some complications and early failures, the overall results are promising. Improving preoperative evaluation, surgical techniques, and postoperative care can enhance the success rates and patient outcomes. Continued research and refinement of surgical practices are necessary to further optimize vascular access for hemodialysis.

Limitations of the Study

This study has several limitations. It is a single-center study, which may affect the generalizability of the results to other settings. The retrospective design may also introduce biases related to incomplete data or variability in clinical practice. Further multicenter, prospective studies with larger

sample sizes are needed to validate these findings and provide more comprehensive insights into the factors affecting the success of vascular access surgeries.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest related to this study.

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