SSRG International Journal of Medical Science
ISSN: 2393–9117 / https://doi.org/10.14445/23939117/IJMS-V11I3P103

Volume 11 Issue 3, 11-15, May-Jun 2024

Original Article

Outcomes of Distal Radio-Cephalic Fistula for Hemodialysis

Ali alyaseen[1], Ghanem Ahmad[2], Suliman Ali[3]

[1,2,3]*Department of Vascular Surgery, Tishreen University, Faculty of Medicine, Lattakia, Syria.*

[1]*Corresponding Author : alloush9933@gmail.com*

Received: 02 April 2024 Revised: 05 May 2024 Accepted: 21 May 2024 Published: 04 June 2024

Abstract *- Although a distal radio-cephalic fistula is still recommended as the primary access option in patients undergoing chronic dialysis, it is associated with a high frequency of failure. Objective: The aim of this study was to evaluate the one-year patency rates of distal radio-cephalic arteriovenous fistula. Patients and Methods: A retrospective observational descriptive study was conducted for the period of one year (July 2021 - June 2022) at Tishreen University Hospital in Lattakia-Syria. The study included a group of patients attending the Department of Vascular Surgery and Nephrology who underwent the creation of an arteriovenous fistula to provide vascular access for hemodialysis. Results: The population of patients was predominantly males (57.4%), with a mean age of 51.85±14.5 years. The most common primary diseases causing chronic kidney disease were as follows: hypertension (42.6%), diabetes mellitus (31.5%), and glomerulonephritis (16.7%). The six-month and one-year primary patency rates were 83.3% and 79.6%, respectively, with similar results for secondary patency (83.3% and 79.6%). Rates of patency were significantly higher in males than females, patients younger than 65 years, absence of diabetes mellitus or anemia or peripheral artery disease ($p<0.05$), without any significant correlation with using of antiplatelet drugs(p:0.2) or smoking(p:0.4). The most frequent complications were superficial wound infection (12.9%) and primary failure (12.9%). Conclusion: The current study demonstrated favorable results in the efficiency of distal radio-cephalic fistula as the first choice for vascular access, especially in the absence of risk factors for developing failure.*

Keywords *- Diabetes mellitus, Patency rate, Peripheral artery disease, Primary failure, Syria.*

1. Introduction

As the population ages and the incidence of diabetes rises, Chronic Kidney Disease (CKD) and End-Stage Renal Disease (ESRD) are increasingly common diagnoses with increasing incidence rates and wider prevalence. [1] The National Kidney Foundation, in concordance with the U.S. Renal Data System Annual Data Report in 2012, reported more than 594,000 Americans with end-stage renal disease and more than 415,000 of these patients on hemodialysis. [2]

The number of dialysis-dependent patients has increased by over 20 percent since 2000 as a result of the improvement in overall mortality and dialysis techniques. [3] Timely initiation of renal replacement therapy is crucial to prevent uremic complications that are associated with significant morbidity and mortality. [4] These treatments adversely impact the quality of life for patients and contribute to a substantial global burden of disease. [5]

According to KDOQI guidelines, autogenous Arteriovenous Fistula (AVF) is the vascular access of choice for dialysis-dependent patients because of a lower rate of complications compared with Central Venous Catheter (CVC) and arteriovenous graft. [1,6] Distal radio-cephalic fistula at the wrist represents the first favorable option, which provides sufficient blood flow for hemodialysis, involves a superficial vein that extends for a long distance, and provides another proximal location for vascular access when required with a low prevalence of complications. [7]

The rise in prevalence of ESRD and its impact on health care resulted in increasing focus on hemodialysis vascular access, as well as the absence of local studies prompted to conduct of this study. Therefore, the current study aimed to elucidate the primary and secondary patency rates of distal radio-cephalic fistula during the first year of the procedure.

2. Materials and Methods

2.1. Study Population

A retrospective observational descriptive study was conducted on all patients with ESRD who underwent surgically distal radio-cephalic fistula attending the department of vascular surgery at Tishreen University Hospital in Lattakia-Syria during a one-year period (2021-2022). Exclusion criteria were the presence of one of the following: patients younger than 18 years, previous history

of performing fistula in the same limb, peripheral artery disease (PAD) with significant effects on arterial flow in the same limb or those with significant central venous stenosis in the same limb, diameter of radial artery or cephalic vein less than 2 mm, or patients with presence of central venous catheter in the same limb. The following workup included a history and physical examination were performed. Allen test was performed to assess ulnar artery function with the necessity of limb protection from intravenous catheters especially central type.

Screening with Doppler ultrasonography was performed before the procedure by measuring the diameter of the radial artery, cephalic vein, and blood flow through vessels. All procedures were performed under local anesthesia, distally radial artery and cephalic vein were identified, and end-to-side anastomosis was performed.

Patients were monitored on a regular follow-up period: 1 month, 6 months and 1 year with performing Doppler ultrasound if necessary. Fistulas were considered mature depending on the following criteria: vein diameter >6 mm, blood flow via fistula exceeding 600 ml/minute, and located less than 6 mm under the skin surface.

2.2. Ethical Consideration

All patients were provided complete and clear informed consent after discussion about the study. This study was performed following the Declaration of Helsinki.

2.3. Statistical Analysis

Statistical analysis was performed by using the IBM SPSS version20. Basic Descriptive statistics included means, Standard Deviations (SD), median, Frequency and percentages. To examine the relationships and comparisons between the two groups, the chi-square test was used. All the tests were considered significant at a 5% type I error rate($p<0.05$), β:20%, and power of the study:80%.

3. Results

The baseline characteristics of the participants were as shown in Table (1). Ages range from 18 to 80 years (mean 51.85±14.5 years), and patients were divided into two groups according to age as follows: ≤65 years (81.5%) and >65 years (18.5%). Males were 57.4% of the patients and females 42.6%, patients with smoking were 35.2%. Diabetes mellitus was observed in 26 cases (48.1%), anemia in 24 cases (44.4%) and peripheral artery disease (PAD) in 10 cases (18.5%).

The two main causes of renal failure were hypertension (42.6%) and diabetes mellitus (31.5%). Other less common causes were glomerulonephritis (16.7%), polycystic kidney (7.4%) and immune–mediated nephropathy (1.9%). There were 22 (40.7%) patients receiving antiplatelet treatment.

Table 1. Demographic characteristics of the study population

Variable	Result
Age(years)	51.85±14.5
Age groups (n, %) ≤ 65 >65	 44(81.5%) 10(18.5%)
Sex, (n, %) Male Female	 31(57.4%) 23(42.6%)
Smoking	19(35.2%)
Comorbidities Diabetes mellitus Anemia Peripheral artery disease (PAD)	 26(48.1%) 24(44.4%) 10(18.5%)
Antiplatelet drugs	22(40.7%)
Causes of renal failure Hypertension Diabetes mellitus Glomerulonephritis Polycystic kidney Immune–mediated nephropathy	 23(42.6%) 17(31.5%) 9(16.7%) 4(7.4%) 1(1.9%)

The primary patency rate within 6 months was 83.3%, and within a year, 79.6%. The secondary patency rate was similar, respectively.

Table 2. Patency rate of fistula of the study population

Variable	Result
Primary patency	
After 6 months	83.3%
After 12 months	79.6%
Secondary patency	
After 6 months	83.3%
After 12 months	79.6%

There were significant differences in the rates of patency during follow-up periods according to gender, age, presence of diabetes mellitus, anemia and peripheral artery disease ($p<0.05$). The patency rate was significantly higher in male patients than females, in which the 6-month and 12-month fistula patency rates were 93.5% and 87.1% in the male group, while 69.6% and 69.6% in the female group. The patency rate in patients younger than 65 years was significantly higher than older ones at 6 months (88.6% versus 60%, p:0.02) and 12 months (84.1% versus 60%, p:0.01). The presence of diabetes mellitus reduced patency, in which the 6-month and 12-month fistula patency rates were 69.2% and 65.4% in the diabetes group versus 96.4% and 92.9% in the other one. In addition, anemia was associated significantly with lower rates of patency (93.3%

versus 70.8%, p:0.02) at 6 months and (90% versus 66.7%, p:0.03) at 12 months. The patency rates of fistula at 6 and 12 months were higher in the absence of PAD (88.6% versus 60%, p:0.02) and (84.1% versus 60%, p:0.03), respectively. The patency rate of the fistula wasn't affected by the presence of smoking (p:0.4) or using of antiplatelet drugs(p:0.2).

Table 3. Association between characteristics of the study population and patency rate during follow-up

Variable	Patency during 6 months	p-value	Patency during one year	p-value
Gender				
Male	93.5%	0.01	87.1%	0.03
Female	69.6%		69.6%	
Age groups				
≤ 65	88.6%	0.02	84.1%	0.01
>65	60%		60%	
Diabetes mellitus				
Present	69.2%	0.007	65.4%	0.01
Absent	96.4%		92.9%	
Smoking				
Present	78.9%	0.5	73.7%	0.4
Absent	85.7%		82.9%	
Hemoglobin level(g/dL)				
≤ 9	70.8%	0.02	66.7%	0.03
>9	93.3%		90%	
Peripheral artery disease(PAD)	60%	0.02	60%	0.03
Present	88.6%		84.1%	
Absent				
Antiplatelet drugs				
Present	72.7%	0.08	72.7%	0.2
Absent	90.6%		84.4%	

Table 4. Complications of the study population

Variable	Result
Complications	
Superficial wound infection	7(12.9%)
Primary failure	7(12.9%)
Early or late thrombosis	3(5.6%)
Fistula infection	1(1.9%)
Hemorrhage, arterial steal syndrome, venous hypertension	0(0%)

As shown in Table (4), superficial wound infection and primary failure represented the most frequent complications of fistula (12.9%) each complication, followed by early or late thrombosis (5.6%) and fistula infection (1.9%) without any case of hemorrhage or arterial steal syndrome or venous hypertension.

4. Discussion

This is an observational descriptive study of 54 patients with ESRD who underwent hemodialysis to assess the outcomes of distal radio-cephalic fistula regarding patency and complications. This study showed the main findings: the majority of patients were younger than 65 years with the predominance of males. Hypertension and diabetes mellitus represented the most frequent causes of kidney injury. The 6-month and one-year primary patency rate was 83.3% and 79.6%, respectively, as well as corresponding results regarding secondary patency, which might be explained by the absence of initial repair attempts in which there were 3 cases of early and late failure for fistula (two cases were due to thrombosis and one resulting from arteriovenous access infection with associated aneurysmal dilation). There was a significant correlation between sex and patency rates in which high rates were in males, which is in agreement with another studies. It might be related to either reduced diameter of vessels in females [8,9] or due to genetic differences in thrombosis factors [10]. In addition, the patency rates were significantly higher in patients younger than 65 years, which

might be explained by structural changes in the blood vessel wall and endothelial cell dysfunction in older ages.

Furthermore, the patency rates were significantly lower in diabetes patients, and this is in agreement with studies that considered diabetes mellitus as an important risk factor for early or late failure. This correlation might be related to tunica media vasorum calcification that is observed more frequently in forearm arteries than brachium ones, which limits the ability of radial arteries to dilate in response to increasing flow via fistula, and diabetes is associated with thrombosis state and contributes to fistula failure. [11,12] The patency rates were significantly lower in patients with anemia, in which many studies considered anemia as a risk factor for early or late thrombosis. Patients with PAD have significantly lower rates of patency, and this finding agrees with previous studies that considered PAD an important risk factor for early or late failure, in which PAD is associated with structural changes in the blood vessel wall and endothelial cell dysfunction that enhances in response to blood flow disorders resulting from fistula [13]. There was no significant correlation between the patency rates and the following variables: smoking and using of antiplatelet drugs.
Finally, the primary failure and superficial wound infection were the most frequent complications (12.9%), wound infection does not have any effect on fistula patency.
The results of the current study are consistent with the previous studies.

Rooijens et al. (2004) demonstrated in a meta-analysis study in the Netherlands that primary patency during one year is (62.5%) with primary failure (15.3%). [14]
Wu et al. (2015) demonstrated in a systemic review in China that primary patency during one year was (73.6%) with primary failure (12.3%). [15]

Dekhaiya et al. (2015) found in a study conducted in India which included 93 patients whose primary patency during one year was (60%) with primary failure (23.3%). [16]

Prasad et al (2019) showed in a study conducted in India included 500 patients that primary patency rates during one-year were (78%) with primary failure (16%). [17]

5. Conclusion

Distal radio-cephalic fistula is considered the better vascular access procedure for hemodialysis in most cases. However, we suggest exceeding wrist fistula to a higher level of arm if there are multiple risk factors for fistula failure. When there are risk factors for Radio-cephalic fistula failure both surgeon and patient status assess the best choice.

Acknowledgments

We wish to thank all doctors in the Department of Vascular Surgery for their assistance.

References

[1] Anton N. Sidawy, and Bruce A. Perler, *Rutherford's Vascular Surgery and Endovascular Therapy*, Elsevier Health Sciences, pp.1-2736, 2018. [Google Scholar] [Publisher Link]

[2] Annual Data Report: Atlas of Chronic Kidney Disease and End-stage Renal Disease in the United States, United States Renal Data System (USRDS), 2013. [Online]. Available: https://ghdx.healthdata.org/record/united-states-renal-data-system-annual-data-report-2013

[3] Charmaine E. Lok, "Fistula First Initiative: Advantages and Pitfalls," *Clinical Journal of the American Society of Nephrology*, vol. 2, no. 5, pp. 1043-1053, 2007. [CrossRef] [Google Scholar] [Publisher Link]

[4] Boris Bikbov et al., "GBD Chronic Kidney Disease Collaboration, Global, Regional, and National Burden of Chronic Kidney Disease, 1990-2017: A Systematic Analysis for the Global Burden of Disease Study 2017," *GBD Chronic Kidney Disease Collaboration Lancet*, vol. 395, pp.709-733, 2020. [CrossRef] [Google Scholar] [Publisher Link]

[5] Jan Dominik Kampmann et al., "Prevalence and Incidence of Chronic Kidney Disease Stage 3-5- Results from KidDico," *BMC Nephrology*, vol. 24, no. 17, pp. 1-9, 2023. [CrossRef] [Google Scholar] [Publisher Link]

[6] Charmaine E. Lok et al., "KDOQI Clinical Practice Guidelines for Vascular Access: 2019 Update," *American Journal of Kidney Diseases*, vol. 75, no. 4, pp. s1-s164, 2021. [CrossRef] [Google Scholar] [Publisher Link]

[7] Ahmed A. Al-Jaishi et al., "Complications of the Arteriovenous Fistula: A Systematic Review," *Journal of the American Society of Nephrology*, vol. 28, no. 6, pp. 1839-1850, 2017. [CrossRef] [Google Scholar] [Publisher Link]

[8] Baris Afsar, and Rengin Elsurer, "The Primary Arteriovenous Fistula Failure - A Comparison between Diabetic and Non-Diabetic Patients: Glycemic Control Matters," *International Urology and Nephrology*, vol. 44, pp. 575-581, 2012. [CrossRef] [Google Scholar] [Publisher Link]

[9] T. Ernandez et al., "Risk Factors for Early Failure of Native Arteriovenous Fistulas," *Nephron Clinical Practice*, vol. 101, no. 1, pp. c39-c44, 2005. [CrossRef] [Google Scholar] [Publisher Link]

[10] Jan P. Vandenbroucke, and Frits R. Rosendaal, "End Of the Line for "Third Generation- Pill" Controversy?," *The Lancet Journal*, vol. 349, pp. 1113-1114, 1997. [CrossRef] [Google Scholar] [Publisher Link]

[11] Henricus J.T.A.M. Huijbregts et al., "Hospital Specific Aspects Predominantly Determine Primary Failure of Hemodialysis Arteriovenous Fistulas," *Journal of Vascular Surgery*, vol. 45, no. 5, pp. 962-967, 2007. [CrossRef] [Google Scholar] [Publisher Link]

[12] Osende I. Julio et al., "Blood Thrombogenicity in Type 2 Diabetes Mellitus Patients is Associated with Glycemic Control," *Journal of the American College of Cardiology*, vol. 38, no. 5, pp. 1307-1312, 2001. [CrossRef] [Google Scholar] [Publisher Link]

[13] Edward G. Lakatta, "Arterial and Cardiac Aging: Major Shareholders in Cardiovascular Disease Enterprises: Part III Cellular and Molecular Clues to Heart and Arterial Aging," *Circulation*, vol. 107, no. 3, pp. 490-497, 2003. [CrossRef] [Google Scholar] [Publisher Link]

[14] P.P.G.M. Rooijens et al., "Radiocephalic Wrist Arteriovenous Fistula for Hemodialysis: Meta-analysis Indicates a High Primary Failure Rate," *European Journal of Vascular and Endovascular Surgery*, vol. 28, no. 6, pp. 583-589, 2004. [CrossRef] [Google Scholar] [Publisher Link]

[15] Cong Cong Wu et al., "The Outcome of the Proximal Radial Artery Arteriovenous Fistula," *Journal of Vascular Surgery*, vol. 61, no. 3, pp. 802-808, 2015. [CrossRef] [Google Scholar] [Publisher Link]

[16] Firdaus A. Dekhaiya et al., "A Prospective Study of Arteriovenous Fistula Creation in Chronic Renal Failure Patients in Bhavnagar, Gujarat, western India," *International Journal of Medical Science and Public Health*, vol. 5, no. 2, pp.228-232, 2016. [CrossRef] [Google Scholar] [Publisher Link]

[17] Prasad Narayan et al., "Outcomes of Radiocephalic Fistula Created by Nephrologists," *The Journal of Vascular Access*, vol. 20, no. 6, pp. 615-620, 2019. [CrossRef] [Google Scholar] [Publisher Link]