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Endovascular Fistula Salvage for Preserving Arteriovenous Fistula Failure in Haemodialysis Patient: Tertiary Referral Hospital, a Single-Centre Experience

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Abstract: Efficacy of endovascular intervention for the preservation of failing accesses is very important in hemodialysis patients. This study aimed to determine the efficacy of endovascular balloon angioplasty in preserving the patency of hemodialysis arteriovenous fistula (AVF) failure. This was a retrospective study of hemodialysis patients who received endovascular intervention due to access difficulties. A single-center study was created between January 2022 and June 2022. Fistulography was conducted on patients suspected of having access stenosis, and balloon angioplasty was performed in the same setting if stenosis of 50% was confirmed. Post-operative complications and access restenosis or failure were monitored. The results obtained 69 patients with hemodialysis access failure due to AVF stenosis, occlusion, and thrombosis that were admitted or referred to our hospital. The majority of patients were 40-60 years (50.7%); 88.4% patients were male and 11.6% were female, with a mean age of 56.3±11.6 (range, 18–77). The sites of AVF failure were brachiocephalic (81.1%) and radiocephalic (18.9%). There was no complication recorded. The procedure succes rate was 81.1%. In conclusion, endovascular balloon angioplasty is effective in restoring hemodialysis access patency. Recurrence is common, and interventions must be repeated. Keeping access open can save lives. Percutaneous transluminal angioplasty (PTA) can be used to achieve safely and successfully repair arteriovenous fistulas failure.
Keywords: angioplasty; arteriovenous fistula; arteriovenous graft; hemodialysis

INTRODUCTION

The major mode of renal replacement therapy, hemodialysis, is dependent on the capacity to maintain excellent vascular access capable of sustaining high blood flow rates. Because of its higher patency and reduced complication rates compared to grafts and catheters, the natural arteriovenous fistula (AVF) is suggested as the first choice. In the hemodialysis population, vascular access failure is a major source of morbidity and hospitalization.[1]

Patients on hemodialysis with chronic end-stage renal failure require autogenous AVFs and prosthetic arteriovenous grafts (AVG). The AVFs have a longer patency than AVGs, therefore, they are the preferred first hemodialysis access. On the other hand, AVGs continue to be clinically essential in patients for whom AVFs are not possible, as well as maybe in particular groups such as the elderly.[2]

While facing such failing fistulas in the past, the customary solution was to abandon the access entirely, place a temporary catheter, and arrange for a new access. However, given the limited number of access sites available for each patient and the increasing life expectancy of patients on regular hemodialysis, the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines recommend early detection and treatment of all hemodynamically significant fistula stenoses, both to maximize the life span of each access and to avoid the need for a temporary hemodialysis catheter.[3]

Multiple salvage methods will eventually be required to restore functionality or create a new access. Some individuals require the implantation of central venous catheters until their hemodialysis access is restored. Albeit, to prevent access failure, doctors can monitor the performance of these accesses and provide preventive therapies to correct hemodynamic issues and prolong their patency.[1]

Hemodialysis vascular access malfunction (which leads to failure) is divided into two categories, namely early and late failures. Early failure has been characterized clinically as an AVF that never develops properly for dialysis (failure to mature) or fails within three months of initiating dialysis. Late failure is defined as failure occurring more than three months after the fistula was constructed or used. Hemodialysis accesses are prone to thrombosis, which is frequently associated with stenosis over the anastomosis or outflow vein. Access thrombosis usually necessitates semiemergent salvage operations, but the results are generally negative.[4]

The purpose of this study was to assess the efficacy of endovascular intervention for the preservation of failing accesses.

METHODS

The retrospective, single-center study was conducted from January 2022 to June 2022. Patients on hemodialysis who had endovascular intervention for access problems were studied retrospectively. Fistulography was conducted on patients suspected of having access stenosis, and balloon angioplasty was performed in the same setting if a stenosis of 50% was found. Post-operative complications and access restenosis or failure were monitored in the patients.

A failing AVF was defined by one or more of the following characteristics: a) decreased thrill of vascular access assessed by palpation by physician; b) documented decreased dialysis flow rate defined by KDOQI guidelines (access flow less than 600 ml/min, or less than 1000 ml/min with a more than 25% decrease over a 4-month period); c) stenosis detected by duplex ultrasound; and d) nonmaturation of an AVF six weeks after creation.

All patients had one or more of the previously stated vascular access failure features. During fistulography, the degree of stenosis in the peri-anastomotic region, fistula/graft, outflow vein, and central veins was assessed. Endovascular intervention in the form of balloon angioplasty was performed in the same setting if angiography revealed a stenosis of 50% or more of the vessel diameter, using either a simple Wanda balloon (Boston Scientific, Natick, MA, USA) or a peripheral cutting balloon (Boston Scientific, Natick, MA, USA). Cutting balloons were used for high grade stenosis (90% stenosis) or total occlusion on fistulography, or when a simple balloon

failed to restore access patency satisfactorily (re-stenosis >50%). Following angioplasty, a completion fistulogram was performed. To determine the success of the procedure and residual stenosis, a completion fistulogram was performed immediately after angioplasty. All patients were observed in the day surgery ward for two to three hours before being discharged if there were no acute complications (bleeding or thrombosis).

Postintervention outcomes included immediate success rate (defined as the ability to perform three successful hemodialysis sessions through the treated fistula; angiographic success: defined as restoration of luminal diameter with less than a 30% residual diameter stenosis; and technical success: restoration of a good propagating thrill, 6-month success rate, and complications such as hematoma, thrombus, and infection.

Data were presented in terms of n and percentage for categorical data and mean (min-max) for numerical data. The Kaplan-Meier method was used to calculate hemodialysis access patency rates following initial salvage angioplasty. Calculations were done using Microsoft Excel and SPSS programs (Statistical Package for the Social Science version 25, SPSS Inc., Chicago, USA).

RESULTS

During the study period, 69 patients with hemodialysis accesses had AVF stenosis confirmed by fistulogram and underwent balloon angioplasty for regaining access. Table 1 showed that the majority of patients were aged between 40 and 60 years old, which was 35 patients (50.7%). Based on sex, 36 (52.1%) patients were male and 33 (47.8%) were female. The sites of failing AVF was brachiocephalic 56 (81.1%) and radiocephalic 13 (18.9%). Medical comorbidities were common among the studied population: 64 patients had hypertension (92.7%), 55 had diabetes mellitus (79.7%), and 35 patients were active smokers (50.7%).

The AVF dysfunction types were stenosis in 44 patients (63.7%), thrombosis in 4 (5.7%), stenosis and thrombosis in 11 (15.9%), and total occlusion in 10 (14.4%) patients. As shown, the site of the most stenosis was in the draining vein, which was 33 patients (35,8%). Degrees of stenosis were 50-80% stenosis in 19 patients (27.5%), and ≥80% stenosis in 50 (72.4%) patients. Stenotic number <2 was found in 42 (60.8%) patients and >2 in 27 (39,1%) patients.

Table 1. Demographical data

Variables	N (%)
Age (years)	
<40	7 (10.1)
40 – 60	35 (50.7)
>60	27 (39.1)
Sex	
Male	61 (88,4)
Femal	8 (11.6)
Location of AVF	
Brachiocephalic	56 (81.1)
Radiocephalic	13 (18.9)
Hypertension	
Yes	64 (92.7)
No	5 (7.2)
Diabetes mellitus	
Yes	55 (79.7)
No	14 (20.2)
Smokers	
Yes	61 (88,4)
No	8 (11.6)

Lesions were treated using plain old balloon angioplasty (POBA) in 51 (73.9%) patients, cutting balloons (CB) in two (2.8%) patients, drug-eluting bead transarterial chemoembolization (DEB) in two (2.8%) patients, percutaneous mechanical thrombectomy (PMT) in five (7.2%) patients, open thrombectomy in two (2.8%) patients, and not treated in seven (10.1%) patients.

In the current study, accesses were outflow in 45 (66.1%) patients, and inflow in 23 (33.8%) patients. Punction sites were radial artery in 16 (22.8%) patients, ulnar artery in two (2.8%), patients, brachial artery in five (7.1%) patients, and draining vein in 47 (67.1%) patients. Sheath sizes were 5 fr in 24 (36.9%) patients, 6 fr in 32 (49.2%) patients, and 7 fr in nine (13.8%) patients. There was no complication recorded. The procedure success rate was 56 (81.1%) patients.

DISCUSSION

Restoring and maintaining AV access patency is essential for patients on maintenance hemodialysis. There is no convincing evidence as to whether open surgery is superior to the endovascular technique to save clotted AV access or vice versa. The choice of technique to use therefore depends largely on institutional preference. This study reported on the institution's experience in introducing the endovascular technique as a first measure to save clotted AV access.[5]

In the study, most clotted AV accesses were successfully saved by endovascular technique with high technical and clinical success rates. Clinical success rates were 81.1%. The rescue of a clotted vascular access is not limited to the short-term result of restoring its function; it is also aimed at increasing functional longevity, mainly located in the drain tanks. The inflow artery was the least common localization, which also correlates with observations from other studies. Obstructive lesions of AVF require either endovascular or surgical revascularization. Percutaneous angioplasty of dysfunctional fistulas is a safe method of treatment.[6-8]

Salako et al[9] in Nigeria, showed that the primary failure of AVF was more common in diabetic patient and thrombosis as the most common cause for primary failure. Arteriovenous fistula creation had very good outcome in well selected patient. Yadav et al[10] in India reported that in 71 patients with clinical symptomps of dysfunctional hemodialysis AVF included low flows during hemodialysis, absent flow, and failure of fistula maturation were treated with endovascular therapy. The result of this study was endovascular therapy for salvage of nonfunctioning hemodialysis AVF was associated with a high-clinical success rate and low-complication rate. Franco et al[11] in Brazil conducted a retrospective study and showed that even in patient with thrombosed acessed of AVF and had threat, endovascular treatment achieved good result and outcome and maintaned its long-term patency.

The results of surgical and endovascular treatment are consistent with each other. Due to the fact that there are only a small number of studies comparing these two methods and no available guidelines, it is not possible to make an evidence-based decision about the choice of treatment. Often the choice of the respective technique is limited to the method practiced in the respective center. Endovascular techniques are less invasive than surgery.[7] In addition, after percutaneous angioplasty, the treated fistula can be catheterized earlier and used as an effective hemodialysis access (usually after two weeks). In the case of surgical interventions, this period is significantly longer. There is little evidence to support the mentioned course of pharmacological treatment and it is inconclusive whether antiplatelet or anticoagulant therapy should be used in patients after AVF repair. Since appropriate pharmacological therapy can affect immediate and long-term treatment outcomes of AVF dysfunction, this topic should be addressed in further studies.[8]

CONCLUSION

Endovascular balloon angioplasty is effective in restoring hemodialysis access patency. Recurrence is common, and interventions must be repeated. Keeping access open can save lives. Percutaneous transluminal angioplasty (PTA) can be used to safely and successfully repair arteriovenous fistulas failure.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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