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Outcomes of Endovascular Intervention for Salvage of Failing Hemodialysis Access

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Abstract: Chronic kidney disease (CKD) is a worldwide public health problem. Hemodialysis accesses are prone to failure due to thrombosis and stenosis over the anastomosis or outflow vein. This study aimed to obtain the outcomes of endovascular intervention for salvage of failing hemodialysis access. This was a retrospective and descriptibe study. Data were collected from all patients who underwent endovascular intervention for failing hemodialysis access starting from January 2021 – June 2023 at Prof. Dr. R. D. Kandou Hospital, Manado. The results showed that 136 subjects were included in this study. The highest comorbidities were found in patients with a history of hypertension (52.9%). The most common arteriovenous fistulas (AVF) hemodialysis access was at the brachiocephalic location (75.7%). The most frequent cause of access dysfunction was simple stenosis (64.7%). Pseudoaneurysm was occurred in two subjects (1.4%), and ruptured outflow vein was occurred in one subject (0.7%). The patency rate at three months was 77.6%, but the primary patency rate would decrease to less than 50% over six months. Endovascular intervention in the form of balloon angioplasty is currently the main line of choice in dealing with problematic AVFs in principle what is being done is to intraluminaly dilate the narrowed or blocked lumen of the outflow vein. The complication rate from the procedure performed was 2.2% where in two patients a pseudoaneurysm occurred at the puncture site, namely the brachial artery and the radial artery then another patient had rupture of the AVFs outflow vein, therefore, an additional procedure was performed to close the AVFs with ligation. In conclusion, endovascular intervention for failing hemodialysis access has good results, but the primary patency rate will decrease to less than 50% over six months.
Keywords: chronic kidney disease; hemodialysis access; endovascular intervention

INTRODUCTION

Chronic kidney disease (CKD) is a worldwide public health problem. Based on the data released by the Indonesian Renal Registry (2018), the incidence of patients with CRF reaches up to 20,000 cases per year with diabetic nephropathy and hypertensive kidney disease as the main causes. According to the Indonesian Nephrology Association (PERNEFRI), about 83% of patients undergoing hemodialysis is end-stage renal disease patients (ESRD) which is a terminal stage of chronic kidney disease (CKD).[1]

Autogenous arteriovenous fistulas (AVF) are necessary for chronic end-stage renal failure patients on hemodialysis. These AVFs are the preferred initial hemodialysis access due to their longer patency than arteriovenous grafts (AVGs).[3] Hemodialysis accesses are prone to failure due to thrombosis, usually concomitant with stenosis over the anastomosis or outflow vein. Access thrombosis frequently requires semi-emergent salvage intervention, but outcomes are generally unfavorable. Patients eventually may require multiple salvage procedures to restore functionality or creation of a new access. Some patients require placement of central venous catheters in the interim whilst the hemodialysis access becomes fully functional. Alternatively, to prevent access failure, clinicians can monitor the performance of these accesses and prophylactically provide endovascular interventions to rectify the hemodynamic problems and prolong their patency.[2]

Our service at Prof. R. D. Kandou Hopspital, Manado, currently offers endovascular interventions, specifically using balloon angioplasty, to hemodialysis patients with access failure. Therefore, this study aimed to assess the effectiveness of endovascular intervention in preserving failing accesses.

METHODS

We performed retrospective data collection on all patients who received endovascular intervention, specifically using balloon angioplasty, for failing hemodialysis access between 2021 and 2023 at Prof. Dr. R. D. Kandou Hospital, Manado. Inclusion criteria for patients who underwent endovascular revascularization intervention were reduced thrill of vascular access assessed by clinical palpation by a vascular surgeon, documented decreased dialysis flow rate defined by Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines (access flow less than 600 ml/min, or less than 1000 ml/min with a more than 25% decrease over a four-month period), documented increased venous pressure during dialysis as defined by KDOQI guidelines (venous pressure of more than 150 mmHg or a trend of persistent increasing pressure over time), stenosis detected by duplex ultrasound, non-maturation of an AVF six weeks post-creation. Patient demographics and co-morbidities were also documented.

Fistulograms were offered to all patients with one or more of the above-mentioned features of vascular access failure. The degree of stenosis in the peri-anastomotic region, fistula/graft, outflow vein and central veins were assessed during fistulography. Endovascular intervention in the form of balloon angioplasty was performed in the same setting if a stenosis of 50% or more of the vessel diameter was detected on angiography, using a simple plain balloon angioplasty. Completion fistulogram was performed immediately after angioplasty to determine the success of the procedure. All patients were observed for one more day in the surgery ward, and then were discharged if no acute complications (bleeding or thrombosis) were detected. The AVFs which were functional for dialysis pre-intervention, were used for dialysis the day after angioplasty.

RESULTS

In total, there were 136 patients with hemodialysis access problems who had stenosis and/or thrombosis after being confirmed by using a fistulogram, and underwent a balloon angioplasty procedure to correct blockages at our installation.

Table 1 showed that there was a gender distribution of males in 69 (50%) patients, and females in 67 (49%) with a mean age of 56.8 years (range of 17-78 years). Medical co-morbidities were common among the studied population, as follows: hypertension (52.9%), type 2 diabetes

mellitus (42.6%), hyperuricemia (26.4%), peripheral vascular disease (8.8%), history of stroke (8.8%), and active smokers (16%).

Out of 136 AVF hemodialysis accesses, 21.3% were radiocephalic AVF, 75.7% were brachiocephalic AVF, and 2.9% were brachiobasilic AVF. The type of hemodialysis access dysfunction according to the results of the fistulogram showed was simple stenosis (64.7%), combined stenosis with thrombosis lesions (19.1%), and lesions with total occlusion (15.4%). Based on the location of the lesion, there were lesions at the juxta anastomosis (52.2%), in the draining vein area (53.6%), lesions in the cephalic arch (17.6%), and lesions at the level of the central vein (10.2%). The severity degree of stenotic lesion findings showed on the fistulogram were 50-80% stenosis (17.6%) and >80% stenosis (78.6%). The failed hemodialysis access was successfully managed with endovascular revascularizations procedures in 103 patients (75.7%) and procedural failure rate in 33 patients (24.2%). There were three (2.2%) post-operative complications, two patients with complications of pseudoaneurysm at the puncture site, each located at brachial and radial artery, and one patient had a ruptured outflow vein after balloon angioplasty and had to undergone additional procedure to ligate and the AVF surgically.

Table 1. Characteristics of patients

Variables	Total (n = 136)
Age	56.8 (17-78) years
Gender (n, %)	
Male	69 (51%)
Female	67 (49%)
Comorbid (n, %)	
Type II diabetes mellitus	58 (42.6%)
Hypertension	72 (52.9%)
Hyperuricemia	36(26.4%)
Peripheral vascular disease	12 (8.8%)
History of stroke	12 (8.8%)
Smoker (n, %)	
Active	22 (16%)
Passive	114 (84%)
AVF hemodialysis access (n, %)	
Radiocephalic	29 (21.3%)
Brachiocephalic	103 (75.7%)
Brachiobasilic	4 (2.9%)
Hemodialysis access dysfunction (n, %)	
Simple stenosis	88 (64.7%)
Combined stenosis with thrombosis lesions	26 (19.1%)
Lesions with total occlusion	21 (15.4%)
Location of the lesion (n, %)	
Juxta anastomosis	71 (52.2%)
Draining vein area	73 (53.6%)
Cephalic arch	24 (17.6%)
Central vein	14 (10.2%)
Severity degree of stenotic lesion (n, %)	
50-80%	24 (17.6%)
>80%	107 (78.6%)
Endovascular revascularization (n, %)	
Successful	103 (75.7%)
Failure	33 (24.2%)
Post-operative complications (n, %)	
Pseudoaneurysm	2 (1.4%)
Ruptured outflow vein	1 (0.7%)
None	133 (97.9%)

Variables	Total (n = 136)
Patency rate (n, %)	
3 months	80 (77.6%)
6 months	42 (40.7%)
9 months	24 (23.3%)
12 months	12 (11.6%)

After initial angioplasty, patients were followed up to determine the patency of the successful procedure, follow-up is carried out in a period of 3, 6, 9, and 12 months. The results obtained were that for a duration of 3 months 80 (77.6%) fistulas were still patent, 6 months 42 (40.7%) patients, 9 months 24 (23.3%) patients and 12 months 12 (11.6%) patients out of a total of 103 patients who successfully performed balloon angioplasty.

From the follow-up study, there were 12 patients who underwent balloon angioplasty for the second time during the study period. From the time duration analysis, the mean between the first and second courses was five months (range 1-16 months). In the analysis of the lesion location according to the results of the fistulogram, it was found that all patients developed lesions in the same location as the previous procedure.

DISCUSSION

Swift access for hemodialysis in the form of arterial-venous fistula (AVF) plays an important role for patients with kidney failure undergoing hemodialysis renal replacement therapy. Compared to double lumen central catheter, the complication rate from AVF is lower, this is confirmed by various studies that have been conducted.[3,4]

However, AVF has the disadvantage of stenosis (narrowing of the lumen of the outflow vein) and thrombosis (formation of a blood clot causing blockage in the outflow vein) which causes failure of hemodialysis access.[6] Data from our study found that the incidence of stenotic lesions was 64.7% followed by a combination of stenosis and thrombosis formation of 19.1% of the total sample of patients who were intervened. [4,5]

Endovascular intervention in the form of balloon angioplasty is currently the main line of choice in dealing with problematic AVF, in principle what is being done is intraluminal dilatation of the narrowed or blocked lumen outflow AVF. The advantage of this type of endovascular intervention is less scar for the patient because it is a minimally invasive procedure, less morbidity and mortality rate compared to surgery, so the patient feels more comfortable and can be discharged 2-3 hours to 1 day after the procedure.[6]

Based from the location of the lesions seen on fistulogram, most were located in the draining vein 53.6% and juxta anastomosis 52.2% followed by cephalic arch 17.6% and central vein stenosis 10.2%. Stenotic and thrombotic lesions in the draining vein are mostly caused by repeated cannulation at the same place (areal cannulation) therefore in various literature it is recommended to perform a rope ladder cannulation technique.[7]

Most of stenotic lesion findings showed a severe degree of stenotic which 107 of 136 patients had >80% stenotic degree. This indicates that the average patient who undergoes endovascular revascularization is already in the fistula stage where the fistula is completely blocked, sometimes there are patients whose fistula is blocked for more than 1 week to 1 month. This of course greatly affects the success rate of the action.

The success rate of endovascular intervention in this study was found to be 75.7% (103 of a total 136 patients), whereas the failures rate was 24.4%. There are various factors that affect the success rate of the action, one of which is the duration from the initial presentation, therefore, early detection of failing hemodialysis accesses is very important.

The complication rate from the procedure performed was 2.2% (three patients), where in two patients a pseudoaneurysm occurred at the puncture site, namely the brachial artery and the radial artery, and another patient had rupture of the AVF outflow vein, so, an additional procedure was

performed to close the AVF with ligation procedure.[8,9]

The endovascular intervention performed on this study used simple plain old balloon angioplasty (POBA) and the patency rate after 12 months was only 11.6% which was lower compared to the results reported by other researchers in the literature, which was 20-40%. This is indeed one of the weaknesses of POBA, therefore, drug-eluting balloon angioplasty technology is currently being developed with better 12-month patency results.[10]

This study had several limitations. First, this was a single-center conducted study in a tertiary care center usng selected population with a possible bias toward more complicated patients; second, this study did not collect any quantitative data on the clinical performance of vascular access.[11]

CONCLUSION

Endovascular intervention for failing hemodialysis access has good results, albeit, the primary patency rate will decrease to less than 50% over six months.

Conflict of Interest

There is no conflict of interest in this study.

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