Endovascular management of peri-anastomotic venous stenosis in renal dialysis arterio-venous fistula

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Abstract Endovascular treatment of the malfunctioning fistula can involve a combination of angioplasty, stenting and the use of thrombolysis with low reported mortality and morbidity. The primary aim of the study was to determine the primary patency and primary assisted patency rates of angioplasty for the treatment of peri-anastomotic stenosis of renal dialysis arterio-venous fistulas (AVFs). The secondary purposes were to identify the factors that may impact restenosis rate and to evaluate the need for close surveillance of AVF. This is a retrospective analysis of AVF angioplasty for peri-anastomotic stenosis. Between August 2009 and March 2012, 44 patients with autologous AVF were treated with percutaneous transluminal angioplasty (PTA). The technical success rate was 100%. 23 of the 44 patients (52.3%) required repeated intervention during the follow-up period. Our primary patency rate at 1 year was 62.5% and the primary assisted patency rate was 96.9% at 1 year. No immediate post-procedure complications.

Conclusion: Endovascular management of peri-anastomotic stenosis in renal dialysis AVF is an effective approach with low morbidity and mortality rates. The higher primary assisted patency compared to the primary patency rate emphasizes the need for close surveillance of AVF and low threshold for early re-intervention.

1. Introduction

The increasing number of patients with end-stage renal disease has broadened the need for reliable vascular access (1).

Since the advent of hemodialysis in 1944 and the subsequent use of AVF as a long-term vascular access, there has been a drastic increase in both the availability of hemodialysis and long-term survival of patients with chronic renal failure (2).

Either a radio-cephalic or brachiocephalic AVF created using the patient’s native vein provides the best possible vascular access for hemodialysis (3).

Two factors are necessary for an AVF to be usable as dialysis access; it must have adequate blood flow, and it must have a size that will allow for cannulation (4).
Increasing fistula prevalence depends on improving the maturation of fistulas that fail to mature and enhancing the long-term patency of mature fistulas (5).

Dysfunction of AVF occurs frequently in hemodialysis patients and contributes significantly to morbidity and hospitalization in the dialysis population (3).

Early fistula failure is frequently due to anatomic lesions that may exist anywhere within the access circuit. Arterial inflow lesions include anatomically small vessels and atherosclerotic disease, which are found in an increasing portion of the elderly, and patients with hypertension and diabetes. Arteriovenous anastomotic and venous swing point stenoses are commonly seen acquired lesions, as these are the sites of surgical creation and mobilization of the artery and vein. Venous outflow and central venous lesions, may be due to pre-existing anomalies, such as anatomically small veins, fibrotic or stenotic veins, or sites of prior puncture or catheter placement. In addition, venous outflow problems may be due to accessory veins or side branches (6–9).

A reduction of vessel diameter 50% associated with a reduction in access flow during dialysis or previous thrombosis, indicates the need for intervention. In radiocephalic AVF, 55–75% of stenoses are located close to the AV anastomosis and 25% in the outflow tract (10,11).

The traditional therapy for failing hemodialysis access has been surgical revision where a patch of angioplasty is usually performed to correct vascular narrowing due to a venous anastomosis stenosis (12).

These stenoses can also be treated by percutaneous transluminal angioplasty (PTA) whose main advantages are usually a better preservation of the venous capital, immediate availability of the fistula for dialysis, and a slightly less invasive nature. Although many studies have reported the results of angioplasty or surgery in the management of failing AVF, few studies have specifically evaluated these anastomotic stenoses (13).

Therefore, the primary aim of the study was to determine the primary and primary assisted patency rates of endovascular management in the treatment of perianastomotic stenosis of renal dialysis AVF. The secondary purposes were to identify the factors that may impact restenosis rate and to evaluate the need for close surveillance of AVF.

### 2. Materials and methods

This is a retrospective analysis of AV fistula angioplasty for peri-anastomotic stenosis.

Between August 2009 and March 2012, 44 patients (27 men, 17 women), aged 36–89 years with a mean of 64.3 ± 14.4 years with autologous AVF were treated with percutaneous angioplasty. 25 patients had a radio-cephalic AVF, 14 had a brachiocephalic AVF and 5 had brachiobasilic AVF.

10 procedures were performed on non-maturing fistulas in patients who were not yet on dialysis. One patient had a mature fistula, but did not start dialysis yet.

Patients were diagnosed with AVF stenosis during surveillance Doppler ultrasound or referred by nephrologists.

All patients had a Doppler ultrasound examination first to assess patency and flow volume of the AVF. The Doppler criteria for intervention included the following: 1. Visible lumen narrowing on gray scale ultrasound and aliasing on color Doppler at the site of stenosis; 2. Fistula flow volume of <400 ml/min in pre-dialysis fistula; and <600 ml/min in patients on dialysis.

The procedure was performed under local anesthesia. Retrograde puncture of the outflow vein of the AV fistula was performed in all cases in a standard Seldinger technique, and a 6 Fr sheath was inserted. The peri-anastomotic stenosis was negotiated with a 0.035-in. hydrophilic-coated guide-wire and a diagnostic catheter, followed by the balloon catheter passed over the guide-wire. The size of the balloon chosen was depending on the diameter of the normal vessel adjacent to the area to be dilated. The balloon sizes used in our study ranged from 4 to 10 mm with 6 mm balloon being the most commonly used size. Under pressure control, the balloon was inflated slowly until the waist disappeared (Fig. 1).

We inserted Misago (Terumo, Tokyo, Japan) self-expandable metallic stents in the primary setting in 7 cases due to vessel re-stenosis after balloon angioplasty. The stents’ sizes were either 7 or 8 mm in diameter and all were 40 mm in length.

All patients were on surveillance program, and the routine is to have the first Doppler examination one month after the procedure.
post-procedure, then every three to six months. No patients were lost for follow-up.

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were expressed using number and percent. Quantitative data were tested for normality and were expressed in mean ± SD. Significance of the obtained results was judged at the 5% level.

3. Results

The technical success rate was 100%. Our criterion for technical success was achievement of less than 30% angiographic residual stenosis. The diameter of the stenotic vessel was measured on the workstation of the angiography machine after angioplasty and was compared to the diameter of the adjacent normal vessel, and a decrease of 30% or less in the diameter of the angioplastied vessel was considered a technical success. Confirmation with on-table Doppler examination was not always required.

No immediate post-procedure complications were encountered in terms of fistula rupture, significant hematoma or fistula thrombosis. No 30-day mortality was reported.

23 of the 44 patients (52.3%) required repeated intervention during the follow-up period; 19 had repeated balloon angioplasty, 3 had angioplasty and stent insertion, and 1 patient had insertion of a new stent within the initially inserted stent. 20 of the 44 patients did not require further intervention during the follow-up period. Only one patient (2.3%) presented after 6 days with thrombosed AVF. The period between primary and re-intervention ranged from 1 to 35 months with an average of 13 months.

The follow-up period ranged from 12 to 42 months in the form of Doppler examination and clinical follow-up during dialysis. 5 patients had a successful renal transplant after at least one year of the procedure, where the fistula was still functioning well.

Primary patency is defined as uninterrupted patency without any additional procedure of the previously treated lesion. The mean primary patency of the whole study group was 12.6 ± 9.5 months ranging from 6 days to 35 months.

12 patients died before completing 1 year of follow-up, while 32 of the 44 patients were alive for a year or more. The primary patency rate at 1 year was calculated among those 32 patients.
There is an increasing demand for reliable, long-term hemodialysis access and as life expectancy in patients with renal failure rises, there will be increasing need for techniques to maintain patency of AVF. The limitations of failure to mature, stenosis and occlusion pose important clinical challenges in providing long-term dialysis access (14,15).

Patients may require the formation of several fistulas over their life and this can eventually lead to problems in finding suitable access vessels. Preservation of existing fistulas by surgical or endovascular means therefore offers a logical approach wherever possible. Endovascular treatment of the malfunctioning fistula can involve a combination of angioplasty, stenting and the use of thrombolysis with low reported mortality and morbidity (14).

In our study, the technical success rate was 100% in 44 patients, this compared to Coskun et al. (1); where PTA was successful in 20 of the 24 patients (83.33%) with first-time dilated stenoses. Long et al. (13) also reported a technical success rate of 92.3%.

Our primary patency (PP) rate at 1 year was 62.5% and the primary assisted patency (PAP) rate was 96.9% at 1 year. This is compared to Long et al. (13), who reported PP rate of 41% at 1 year and a PAP rate of 92% at 1 year. The difference between the PP and PAP rates illustrates the value of post-angioplasty surveillance scheme and early re-intervention to maintain the AVF patency.

From the available patient’s records we studied the factors which could have an impact on the re-stenosis rate including patient’s factors such as age, sex, diabetes and hypertension and pre-interventional factors including stenosis of the anastomosis itself and the AVF being used for dialysis or still a pre-dialysis patient as well as usage of a stent intra-operatively or not. We could not find full record of smoking habits for all patients. Only one variable was independent risk factor for stenosis recurrence: stenosis site at the anastomosis itself (73.9% confidence interval (CI), \( p = 0.007 \)). This is compared to Long et al. (13) who found stenosis site at the anastomosis itself as a significant risk factor (95%, \( P = .005 \)).

Several complications are known to occur in 2–6% of cases, including venous rupture, the formation of pseudoaneurysms, acute access thrombosis, bacteremia, and contrast material reaction (1). No immediate post-procedure complications were encountered in our series, in terms of fistula rupture, significant hematoma or fistula thrombosis.

5. Conclusion

Endovascular management of peri-anastomotic stenosis in renal dialysis AVF is an effective approach with low morbidity and mortality rates. The higher primary assisted patency compared to the primary patency rate emphasizes the need for close surveillance of AVF and low threshold for early re-intervention. Stenosis of the surgical anastomosis is a significant risk factor for recurrence of stenosis.

It is recommended that patients on dialysis through an AVF should be on a close surveillance scheme including clinical and Doppler evaluation from the time of creation of the fistula and throughout their life to detect signs of dysfunction and allow early intervention.

Conflict of interest

We have no conflict of interest to declare.

References

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