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| RESEARCH ARTICLE

The Effect of Endovascular Management of Arteriovenous Fistulae the Stenosis A Review of Local Experience: A Review of Local Experience

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| ABSTRACT
The objective of this paper is to determine the success of Endovascular procedures (Percutaneous transluminal angioplasty) as an initial procedure to treat dialysis arteriovenous fistula (AVF) stenosis. There were fifty one patients who underwent fifty four vascular access surgeries from May 2009 to February 2011 at the Rangueil Hospital. They were retrospectively evaluated on the base of a duplex ultrasound study and insufficient hemodialysis. Among the fifty four vascular access surgeries, thirteen (24%) were documented as having arteriovenous fistula stenosis, and among them, seven patients (53.8% of the 13 patients) required percutaneous transluminal angioplasty (PTA) as an initial procedure for treatment. Among the accesses that were documented to have arteriovenous fistula stenosis, 71% of lesions were in the juxta-anastomotic area, while 29% were in the venous limb (draining limb). The results of the study revealed that the initial success rate of percutaneous transluminal angioplasty in the treatment of stenotic lesions was 86% of the cases and saved the vascular access site. In these patients, the post-intervention patency at one, three and six months was 86%, 85% and 66%, respectively. It can be concluded that this method is thus a promising form of semi-invasive treatment for symptomatic arteriovenous fistula stenosis.

| KEYWORDS

Hemodialysis; therapeutic PTA; Angioplasty; arteriovenous fistula stenosis; end-stage renal disease.

| ARTICLE INFORMATION

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1. Introduction

In patients with end-stage renal disease (ESRD), vascular access remains the Achilles heel of haemodialysis. From a historical point of view, the primary arteriovenous fistula, created by an anastomosis of the radial artery with the cephalic vein, was first described by Brescia et al. in 1966. The following are prerequisites for adequate dialysis angioaccess: It has to be able to provide a minimum of 200 mL per minute of blood to flow through the dialysis machine and has to accept a similar volume for return (Lower flows make dialysis inefficient); it has to be easily cannulated, it is not sufficient to have a good thrill in an AV fistula the vein has to be superficial, so that needle cannulation can be done safely and easily, in the case of acute access, it must allow immediate use after implantation, In the case of chronic access, it has to allow for repetitive cannulation (i.e., three times per week), and have long-term patency and low rate of complications. Throughout the past decades, this technique has remained the preferred mode of achieving vascular access for haemodialysis.

Maintaining patent vascular access remains a major challenge. Cumulative data show that vascular access is lost prominently from an inability to resolve a thrombotic complication. Over 85% of the documented thrombosis have an anatomical cause, the most common being stenotic lesions at the juxta-anastomotic or along the draining venous limb. Prospective detection and preventive treatment of high-grade stenosis are important since they will improve the patency of vascular access and, hence, decrease the incidence of haemodialysis failure due to fistula loss. Percutaneous transluminal angioplasty (PTA) has been gaining favor in recent years as a therapeutic procedure for correcting stenosis, thereby improving fistula function and prolonging fistula survival.

This article reviews the clinical course and treatment outcome of performing PTA for AVF stenosis among patients on long term haemodialysis.

2. Methods

Patients on long term haemodialysis who underwent dialysis arteriovenous fistula creation between May 2009 to February 2011 at the Rangueil Hospital were reviewed. Among these fifty four vascular accesses, there were 13 accesses (i.e. 24%) that were documented as having arteriovenous fistula stenosis and among them, seven patients (53.8% of the 13 patients) underwent therapeutic PTA. Clinical suspicion of AVF stenosis was based upon abnormal dialysis blood line pressures and routine screening duplex ultrasound. The database was created from operative logs and radiology, nephrology and dialysis center records. The demographic data collected were the sex and age of the patient, history of dialysis catheter placement, number of prior fistula created, and preoperative venous imaging status (Table 1). In each case, preoperative assessment entailed physical examination plus duplex US scanning. The most suitable artery and vein were selected based on this assessment.

Table 1

Number of patients	51
Number of AVFs	54
Sex (M/F)	35/16
Age (median years)	53.5 ± 34.5
median duration of ESRD (months)	13 ± 9
Number of accesses with PVI	54
Body side Rt./Lt.	16/34
anastomosis technique	End-to-side
MAD	0.30 cm ± 0.15
MVD	0.34 cm ± 0.16
AVF type:	
brachio-basilic	13
brachio-cephalic	10
radio-cephalic	30
radio-ulnar	01
total	54

PVI: preoperative vascular imaging

MAD: median of arterial diameter

MVD: median of venous diameter

When insufficient AVF flow for hemodialysis was detected, the first investigative step in each case was duplex US scanning. If the stenosis (defined as more than 50% reduction in luminal diameter documented by the duplex US) was detected anywhere along the AVF, then percutaneous transluminal angioplasty (PTA) was the treatment of choice. Taking into account, there were two cases where a thrombus was found and necessitated thrombectomy before the PTA. In all cases, the success of the procedure was always checked with control fistulography (The success, i.e. primary patency, was considered achieved if there was less than 30 % of the residual stenosis documented in the follow up duplex US studies).

2.1 Angioplasty technique

A 5 to 6-French vascular introducer sheath was inserted percutaneously into the venous limb of the AVF and was directed towards the stenotic segment to be dilated. A set of diagnostic fistulograms was produced. The length and diameter of the stenotic segment were measured using the radiograph of the fistulogram. An angioplasty balloon with a diameter that was 1 mm larger than the adjacent normal vascular segment (usually 5 to 6 mm in diameter) was selected for PTA. The stenosis was traversed with a guide-wire via the introducer sheath. The selected balloon catheter was then inserted across the stenosis using the guide-wire; this was assisted by fluoroscopy. The balloon (noncutting/cutting) was inflated with a pressure inflation syringe until it opened up fully (i.e. until the middle point of the stenosis impinged on the balloon). Inflation was sustained for 60 seconds, and the process was repeated two or three times.

The PTA was considered technically successful if the degree of residual stenosis was less than 30%, as visualized using the fistulogram. A clinically successful PTA procedure was defined as a reduction of venous dialysis pressure to less than 100 mm Hg (for venous stenosis) and/or a reduction of arterial inflow (negative) pressure to less than 75 mm Hg while maintaining a dialysis

blood flow rate of more than 150 mL/min.

3. Results

Seven patients (five men, two women; median age, 61.0 ± 27 years; duration on haemodialysis, 21 months [median, 11 months]) underwent a total of 11 PTA procedures for symptomatic stenosis of their AVF as shown on their fistulography/fistulogram. The median follow-up duration was 11±10 months (range, 1-21 months). The sites of stenosis and their treatment outcome are shown in Table 2.

Table2
Stenosis and treatment outcome

Patient	Sex	age	Duration on HD before PTA (months)	Site of stenosis	Remarks & outcome
1	M	87	3	V†	Successful; recurrent stenosis 3 months later; change anastomosis site.
2	M	78	20	V	Successful
3	M	88	9	V†	Successful; recurrent stenosis 3 months later; had another successful PTA
4	M	34	1	V†	Successful
5	M	45	6	V†	Successful
6	F	49	6	V†	Successful
7	F	83	N	A & V	Technical success; clinical failure (dialysis failure due to insufficient pressure)

A arterial stenosis

V venous stenosis

V† venous stenosis juxta-anastomotic

N never used

One mixed (arterial and venous), five juxta-anastomotic, and one venous (draining limb) lesions were detected by fistulography among the seven patients who were all receiving maintenance haemodialysis via a native AVF in their upper extremity. They presented with abnormal dialysis pressures with physical evidence of stenosis. Five had elevated venous dialysis pressures; two had low arterial inflow pressures, while one (patient 7) had both abnormal venous dialysis and arterial inflow pressures. All patients underwent a duplex ultrasound scan, which showed areas of the stenosis along the AVF's. All the patients underwent intra-operative fistulogram to delineate the exact anatomical location of the stenosis.

Percutaneous transluminal angioplasty performed in all patients with a result of 86% was deemed to have both technical and clinical success (as defined in the Methods). One of these patients (patient 7) had a technically but not clinically successful PTA and was considered a failure (in whom the dialysis could not be performed due to insufficient pressure). Two patients (patients 4 and 6) had recent fistula thrombosis and thrombectomy done before PTA on the same operative set. None of the patients displayed any major complications from the procedure.

4. Discussion

Establishing and maintaining permanent vascular access in haemodialysis patients is an important factor for patient survival. Indeed, the loss of vascular access remains one of the most challenging problems confronting nephrologists and vascular surgeons. Stenotic lesions of native and synthetic fistulae are the most common anatomical causes of thrombosis and account for approximately 85% of cases of fistula dysfunction (Fan, 1992). In a small percentage of cases, thrombosis is caused by hypotension, inadvertent external compression, trauma, or infection. Thrombosis of the fistulae is a problem that leads to significant morbidity, and longer hospital stays for dialysis patients (WINDUS, 1993). In the past, thrombosis of dialysis access was almost always corrected with surgical thrombectomy. Today, there are also numerous percutaneous treatment alternatives for thrombosed access. These include mechanical thrombectomy, pharmacomechanical thrombolysis, and percutaneous infusion of pharmacological agents for thrombolysis (HAAGE, 2000).

The prospective identification and correction of stenosis is of great importance in decreasing fistula thrombosis rates (Schwab, 1989). Only by doing this can the fistula's function and availability be maintained. Methods to detect high-grade stenosis include the use of clinical indicators (Gray, 1995) (the objective measurement of venous dialysis pressure[3] and non-urea recirculation (Windus, 1990), colour duplex ultrasonography (Dousset, 1991), and digital subtraction angiography DSA (Beathard, 1992; Valji, 1995)).

Venous stenosis has traditionally been corrected surgically by extending the fistula further up the involved extremity, thereby minimizing future vascular access sites. Transcatheter techniques have, in recent years, made it possible to treat these lesions percutaneously, and PTA is an excellent method of correcting venous stenosis in both native and synthetic fistulae[7]. It has the advantages of being a shorter procedure than surgery, inciting less stress and discomfort to patients, obviating the need for prolonged hospitalization, having a lower chance of infection, sparing the patient's veins, and, in selected cases, enabling immediate dialysis without the need for a temporary central venous catheter. Table 3

The pathogenesis of venous stenosis is not fully understood. Stenosis is produced by neo-intimal proliferation, which has been attributed to the effects of elevated venous pressure and turbulent blood flow (Valji, 1995; Rekhter, 1993). Turmel-Rodrigues et al. (1993) reported that two thirds of stenosis occurs distal to the arterial needle, while the remaining third occurs proximal to the arterial needle (both are on the venous side). In our series, 71% of lesions were in the juxta-anastomotic areas, while 29% were in the venous limb (draining limb). The success rate of PTA varies in different centers. In general, the cumulative primary patency (which was defined as less than 30% residual stenosis which can be detected by post procedure follow up duplex US) is in the range of 70%-80% at 3 months, 40%-60% at 6 months, and 30%-40% at 12 months, and in our review is 86% at 3 months, 85% at 6 months and 66% at 12 months (Beathard, 1992; Turmel-Rodrigues; 1993). Although PTA and surgery have comparable initial success rates, recurrence is invariably more frequent after the former (Schwab, 1989; Beathard, 1992). Multiple PTA procedures, however, are possible upon a single lesion in a given fistula, thereby prolonging its life span without extension of the fistula further up the arm. No correlation was found between the presence of stenosis and any of the demographic characteristics of the patients, such as age, sex, or duration of dialysis.

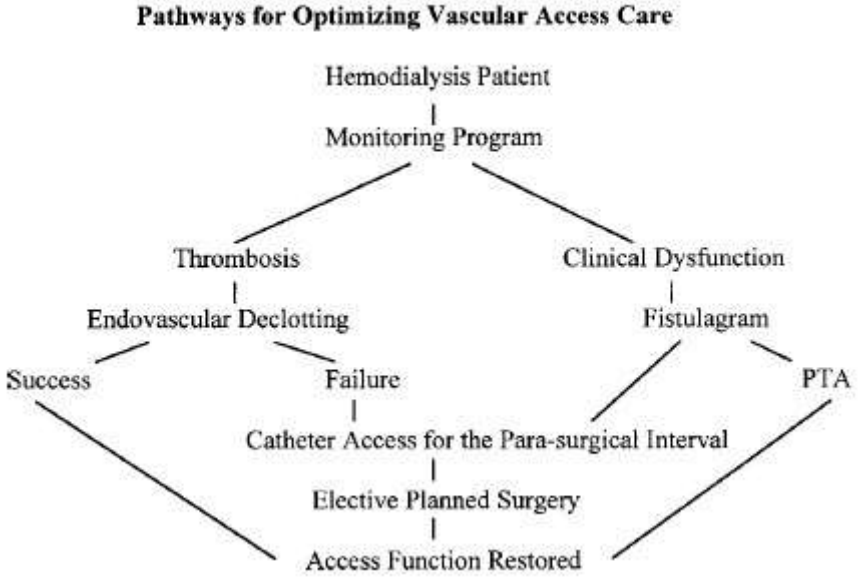
Table 3

	Percutaneous angioplasty	Surgical revision
Outpatient procedure	x	
Access immediately available for dialysis once the lesion is corrected	x	
Lesions in all locations, even those centrally located, can be easily, effectively, and safely treated	x	
Preserves potential venous access sites	x	
Minimally invasive	x	

Elimination of the lesion		x
Effective for severe lesions (>80% of lumen)		x
Loss of potential venous access sites		x
Minimal post procedure discomfort	x	
Occasional need for a temporary access		x
Lesions tend to be recurrent	x	x

Characteristics of AVF stenosis intervention modality[16]

Complications arising from PTA are rare. In one series (Turmel-Rodrigues, 1993) involving 147 PTA procedures, the overall morbidity was 4.8% with one immediate rupture, four delayed pseudo-aneurysms, and periprocedural bacteraemia. In contrast, the most common complication in our series was failure to reach a functioning fistula and the presence of a thrombus with the stenosis, with currently no consensus with regard to the use of anticoagulation prophylaxis for PTA. While most centers would administer heparin 2000 to 4000 U intravenously during PTA procedures, the long-term use of antiplatelet agents such as low-dose aspirin or sulphinpyrazone has been favoured by only some (Abedon, 1993) and disputed by others (Domoto, 1991).



Algorithum 1.1.

5. Conclusion

In conclusion, this retrospective, single-center experience shows the success of PTA as an interventional modality for the treatment of vascular access stenosis in the local hemodialysis population with good efficacy. We found in our study that the initial success rate is up to 86% of the cases and saved the vascular access site with post-intervention patency varies from 66% to 86%. During the study, we noticed that elevated dialysis blood line pressure could be the first sign of fistula stenosis (this needs to be further studied in more research) and with rapid action in the form of PTA saving hemodialysis access. On the other hand, losing patient follow up was considered a significant limitation of the study.

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