# Restoration of acutely thrombosed arterio-venous fistulae by rTPA and percutaneous angioplasty

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**ABSTRACT: Acute thrombosis in native arterio-venous fistulae (AVF) results in considerable patient morbidity. Interventional radiology (IR) comprising thrombolysis and percutaneous transluminal angioplasty (PTA) is well established in the management of thrombosed polytetrafluoroethylene (PTFE) grafts. However its role in thrombosed AVF is uncertain. We looked retrospectively at the role of IR in re-establishing blood flow in acutely thrombosed AVF.**

**Between 1992-2000, 21 episodes of acutely thrombosed AVF in 15 patients (9 females; age range 29-80yrs) were referred for intervention. All fistulae were being used for haemodialysis at the time. Diagnosis was established by angiography and thrombolysis with recombinant tissue plasminogen activator (rTPA) was attempted in all patients. Discrete stenoses when present (n=12) were then treated with PTA and resistant or recurrent stenoses were managed by stent insertion (n=3). Patients were then heparinised for 24 hours.**

**Technical success as defined by radiological patency was achieved in 86% cases. Clinical success i.e. the ability to reuse of the fistula for haemodialysis was achieved in 62% of the interventions, where patency rates at 3 and 6 months were 92% and 69% respectively. Five patients had recurrence of thrombosis >3 months after the primary procedure, 3 had successful re-intervention. Minor local bleeding was the only complication.**

**Our retrospective study shows rTPA and PTA is successful in the management of acutely thrombosed AVF. We advocate the routine use of IR as a valuable technique for prolonging the life of native AVF in patients on maintenance haemodialysis. (The Journal of Vascular Access 2001; 2: 150-153)**

**KEY WORDS:** *Angioplasty, Arterio-venous fistula, Haemodialysis, Interventional radiology, Thrombolysis, Vascular access*

## INTRODUCTION

Native Brescia-Cimino arterio-venous fistulae (AVF) are the preferred method of haemodialysis accesses (1). Compared to polytetrafluoroethylene (PTFE) grafts long-term patency is greater and complications such as thrombosis are fewer (2). However acute thrombosis remains the most common complication in an AVF (3) resulting in considerable patient morbidity and the need to create new access sites. There is little consensus on management of acute thrombosis in an AVF. Bedside treatment like massaging the fistula, systemic heparinisation and systemic thrombolysis with streptokinase or urokinase have been described, but with little evidence of consistent benefits. Surgical thrombectomy has a variable success rate (4, 5). Lack of surgical time and theatre space can be prohibitive. The roles of percutaneous techniques of thrombolysis and angioplasty have been well studied and are of benefit for PTFE graft thrombosis (6, 7). However the role of these interventions in AVF thrombosis has not been extensively studied. We report our retrospective experience of the use of recombinant tissue

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plasminogen activator (rTPA) and percutaneous transluminal angioplasty (PTA) to recanalise thrombosed AVF in our centre over a 9-year period.

## METHODS

Between 1992 and 2000, 15 patients (9 females, age range: 29 to 80 years; median 59 years) with 21 episodes of acute thrombosis in native AVF were referred for thrombolysis and angioplasty. Sixteen episodes were in 10 forearm fistulae and 5 were in 2 upper arm fistulae. All the fistulae were being used for dialysis at the time of the event. All of the procedures were carried out within 24 hours of diagnosis of a thrombosed AVF. Informed written consent was obtained from every patient before the procedure.

We defined technical success as radiological evidence of restoration of patency. A clinically successful procedure was defined as the ability to reuse the fistula for dialysis with a satisfactory blood flow at least once after the intervention. Duration of patency was defined from the time of the procedure to re-intervention or death. Stenosis was defined as 70% narrowing of the internal lumen of the blood vessel and termed as venous, anastomotic or mixed, depending on the location. Long-term survival was calculated by the means of the Kaplan-Meier life-table analysis. The cohort was divided in two groups according to the time scale (1992-1996 and 1997-2000) and success rates were compared by the means of chi-square test.

All patients were reviewed in the dialysis unit and adequacy of blood flow and dialyses were evaluated. Repeat angiography was performed if indicated. Restenosis or re-thrombosis was managed with repeat angioplasty and/or thrombolysis as appropriate.

### *Procedure*

For purposes of diagnosis, access for fistula angiography was achieved by puncture of the femoral or brachial arteries or by cannulation of the venous side of the fistula. Interventional procedures however were performed by antegrade or retrograde puncture of the fistula vein.

An arteriotomy needle was used to puncture the thrombosed vein. If the tip was within the lumen a guide wire passed without resistance. This was then exchanged for a short catheter and an angiogram then identified the clot burden and sometimes also revealed the site and number of any stenoses.

A guide wire (0.035 in) was used to disrupt the clot. Sometimes this re-established flow but it was principally designed to increase the surface area of thrombus which then could be exposed to repeated boluses of 1-3 mg of rTPA which were then instilled until patency was restored or a dose of 15 mg was reached. On one occasion an infusion of rTPA (1 mg/hr for 4 hours) was used. Irrespective of whether flow was re-established, a guide wire was negotiated through any stenosis and angioplasty performed. Balloon dilatation (4-9 mm) required pressures of 9 to12 atmospheres and as much as 15 minutes inflation time. The insertion of a stent was usually reserved for recurrent or highly resistant stenoses.

For all patients in whom radiological evidence of restoration of blood flow was seen, subcutaneous heparin was administered for 24 hours after the procedure to achieve an APTT ratio of 1.5-2.5. If flow was re-established, and an angioplasty apparently successful, a poor flow was often due to spasm and improved within a few hours. In all patients in whom the procedure was radiologically successful the fistula was cannulated at the next dialysis session.

Patients were followed up for at least 6 months.

## RESULTS

In 9 (47%) patients we found no underlying stenosis. Eight patients (38%) had venous stenoses, one patient had an anastomotic stricture and rest had mixed lesions.

Radiological patency was re-established in 18 of the 21 interventions. The procedure was clinically successful and dialysis recommenced in 13 of the 21 (62%) interventions. Between 1992-96, 9 procedures were carried out with 3(33%) clinically successful outcomes. But since 1997, 10 (83%) interventions were clinically successful out of 12 performed (p=0.02) (Fig. 1).

Of the clinically successful procedures patency was 92% at 3 months, 69% at 6 months and 54% at one year (Fig. 2). There was only one re-intervention within the first 3 months.

In 5 patients repeat interventions for re-thrombosis were required at a median of 10 months (range 3-13 months) after the primary procedure. Three of these were clinically successful. Interval angioplasty was needed in 3 of the 13 restored fistulae for persistent high venous pressure. On 3 occasions self-expanding stents were deployed due to resistant stenosis.

Apart from minor bleeding needing local haemostatic measures, there were no major complications associated with any of the interventions. There was

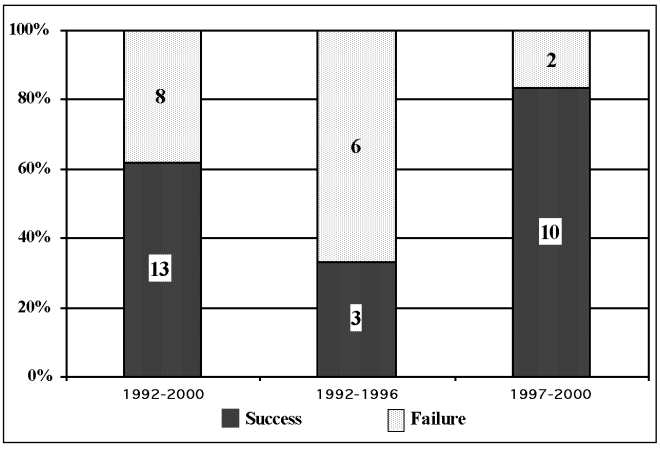


**Fig 1** - ***Clinical success of intervention.***

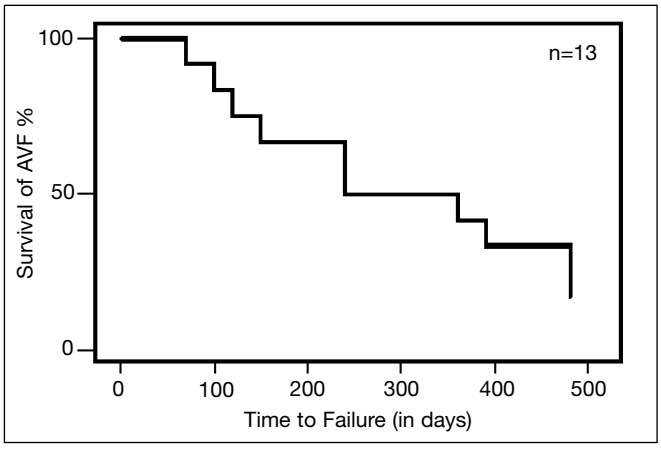


**Fig. 2** - ***Kaplan-Meier survival plot for long-term patency after clinical success.***

no evidence of infection or embolisation associated with any of the procedures. One patient died a month after the procedure with a functioning fistula due to a cerebral infarct; another patient died of acute myocardial infarction on the day following an unsuccessful attempt at thrombolysis using rTPA.

## DISCUSSION

Thrombosis is the most common late complication in arterio-venous fistulae (3). An underlying stenosis on the venous side is responsible for most of the thrombotic episodes (8). Turbulent blood flow across the stenosis predisposes to local thrombosis with hypotension, cannulation trauma and hypercoagulability being other important contributing factors (9).

In the present series there were 21 episodes of acute thrombosis in native AVF over a period of 9 years. The incidence of acute thrombosis of native AVF in our unit is very low, 4.3 thrombotic episodes/100 patient years compared to the National Kidney Foundation – Dialysis Outcomes Quality Initiative (NKF-DOQI) clinical practice guidelines for vascular access of <25 thrombotic episodes/100 patient years (10). This may be attributable to our policy of early angiograms in problem cases.

In many centres still surgical thrombectomy is the only treatment available for acute thrombosis in native AVF. In the last decade various percutaneous techniques have been described using combinations of pharmacological thrombolysis, mechanical thrombolysis and angioplasty (9, 11-14). Technical success, i.e. the restoration of patency radiologically, varied between 76 and 93% using hydrodynamic thrombectomy catheters (84%) (9), hydrolyser catheters (84%) (11), local urokinase infusion with angioplasty (82%) (12), thromboaspiration (76% in upper arm and 93% in forearm AVF) (13) and mechanical thrombectomy (89%) (14). Our technical success rate of 86% was comparable to these results.

Zaleski et al reported on 17 patients who were treated by local urokinase infusion and angioplasty. Patency was 71% at 6 months and 64% at 12 months. More recently Turmel-Rodrigues et al reported 93 procedures on 73 thrombosed native AVF. They used manual catheter directed thrombo-aspiration with or without urokinase infusion followed by angioplasty of underlying stenosis. Patency rates at one year were 49% in forearm fistulae and 9% in upper arm fistulae. Haage et al described percutaneous intervention using mechanical thrombectomy with various devices and balloon angioplasty in 81 cases of thrombosed AVF. Patency rates were 75% at 3 months, 65% at 6 months and 51% at 12 months.

Although we had an overall clinical success rate of 62%, there was a learning curve in the first 5 years. In the last 4 years a success rate of 83% has been achieved. Our long-term patency of 92% at 3 months, 69% at 6 months and 54% at a year (Fig. 2) compares favourably with the results of others. This was achieved using conventional angiographic catheters and rTPA as the thrombolytic agent. All our interventional procedures were performed through a single puncture site, making haemostasis less of a problem at the end of the procedure.

Our series confirms that thrombosis in native AVF is amenable to local thrombolysis and percutaneous transluminal angioplasty. Re-stenosis or re-thrombosis can be dealt with by repeat interven-

tions. From our experience, a learning curve is expected and early failures should not cause interventionists or nephrologists to abandon this valuable procedure that can increase the usable life of the AVF and delay the need for creation of new vascular access. Timely intervention also avoids the need for temporary vascular access, decreasing patient morbidity. Our results suggest routine referral of all acutely thrombosed native AVF for interventional radiology.

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