

# Treatment of Venous Outflow Stenosis in Hemodialysis Arteriovenous Fistulae using Percutaneous Transluminal Angioplasty: Our Experience at King Hussein Medical Center

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## ABSTRACT

**Objective:** To evaluate the technical success and primary patency of percutaneous transluminal angioplasty as a modality of treatment for outflow venous stenosis in arteriovenous fistulae used as hemodialysis access.

**Methods:** This is a retrospective, single center review which was conducted between August 2008 to August 2009, analyzing the results of percutaneous transluminal angioplasty used to treat 49 patients with short segment venous outflow stenosis. Patency was assessed by clinical examination and Doppler ultrasound scanning over a follow up period of one year.

**Results:** The immediate technical success rate of percutaneous transluminal angioplasty was 98%. The primary patency at six months, and one year were 83% and 53% respectively. One patient developed rupture of the vein at the site of angioplasty. Six patients died during the follow up period. The deaths were not related to the procedure or access failure.

**Conclusion:** Percutaneous transluminal angioplasty is an effective method for treatment of venous outflow stenosis in surgically created arteriovenous fistulae, with excellent technical success, acceptable one year primary patency, and low complications rate.

**Key words:** Arteriovenous fistula, dialysis access, outflow venous stenosis, percutaneous transluminal angioplasty

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## Introduction

In recent years, we have been faced with an increasing number of patients who suffer from end stage renal disease. Such patients require hemodialysis through an access that offers rapid blood flow of adequate volume.<sup>(1)</sup> Surgically created arteriovenous fistulae are commonly used as hemodialysis accesses in our hospital, because of the decreased incidence of associated complications, and longer patency compared to arteriovenous grafts.

Dysfunction and even thrombosis and failure of arteriovenous fistulae are not uncommon, and the commonest cause of dialysis access dysfunction in general is venous stenosis caused by neointimal hyperplasia.<sup>(2)</sup>

Percutaneous transluminal angioplasty (PTA) offers a relatively minimally invasive, and safe treatment option which corrects the venous stenosis effectively,<sup>(1,3-5)</sup> and prolongs the access patency duration.<sup>(6-8)</sup> However, for juxta-anastomotic stenotic lesions within four centimeters from the anastomosis,

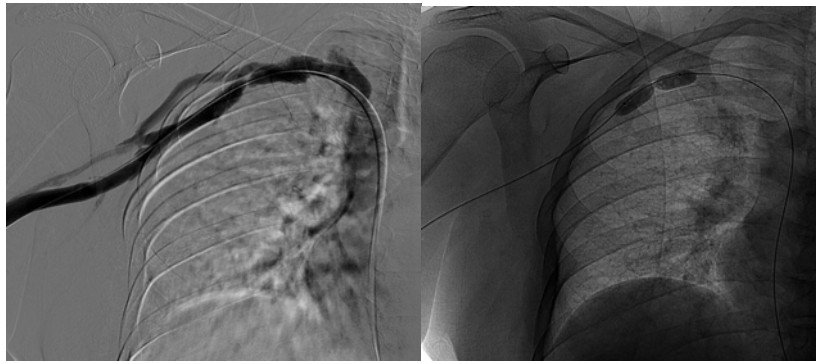
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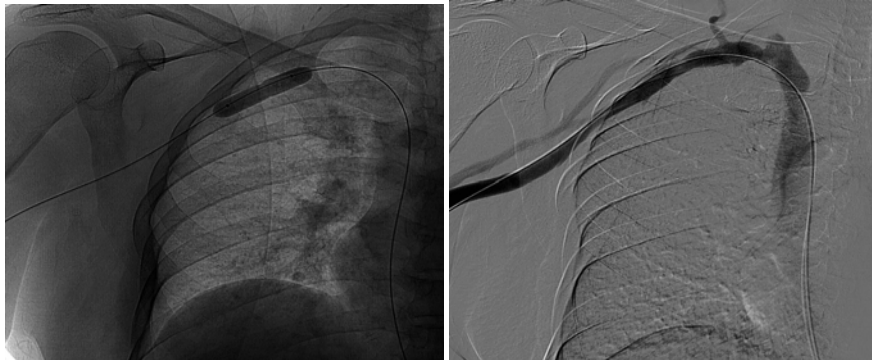
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**Figure 1A**

**Figure 1B**

**Fig. 1:** 54 years old patient with right upper extremity fistula complain of limb swelling  
**A:** Fistulogram demonstrates significant stenosis in the outflow axillary vein  
**B:** Wasting of balloon during early inflation at the site of stenosis



**Figure 1C**

**Figure 1D**

**Figure 1:** Same patient during inflation of balloon and final fistulogram  
**C:** Balloon catheter fully inflated at stenosis site  
**D:** Completion angiogram demonstrates no significant residual stenosis

and long in lesions more than four centimetres in length, surgical intervention is advised.<sup>(9)</sup>

This is a retrospective, single centre review, which was conducted at King Hussein Medical Centre to assess the results of PTA performed to treat 49 significant, short segment venous outflow stenosis encountered in symptomatic patients.

## Methods

During the period from August 2008 to August 2010, a total of 58 patients with previously functioning arteriovenous hemodialysis fistulae, were referred to the interventional radiology service at our institution, with symptoms and signs related to venous outflow stenosis.

The clinical presentation included increased venous pressure during dialysis (20 patients), enlarging venous aneurysm (5 patients), and limb edema (33 patients). Doppler ultrasound was performed for all patients and confirmed the presence of venous stenosis suggested by the clinical presentation.

A fistulogram was performed via a direct venous puncture. A full study of the draining venous system was performed. A pressure cuff inflated distal to the fistula was used to occlude the venous drainage temporarily, and a reflux fistulogram was performed to evaluate the arteriovenous anastomosis, and the arterial supply of the fistula. Digital subtraction imaging and low osmolar, nonionic contrast was used in all cases.

Nine patients were excluded from our study because co-existing juxta-anastomotic stenotic lesion (2 patients), long segment stenosis in the outflow veins (2 patients), complete occlusion of the outflow vein (2 patients), or multiple stenosis of the outflow veins (3 patients). The remaining 49 patients (27 males, 22 females), with an age range of 38 to 67 years (mean age of 57 years), were included in the study. These patients were diagnosed to have single, short (less than 4 cm), significant venous outflow stenosis, defined as a reduction of the vessel diameter of more than 50% in relation to the normal vessel diameter distal to the stenosis.<sup>(10,11)</sup>

**Table I:** Technical success and complications among the study group

	<b>Patients Number</b>	<b>Patients (%)</b>
Technical Success	48	98
Major Complication	1	2
Minor Complication	2	4

The lesions were crossed with angled glide, 0.035 inch, hydrophilic coated Guide wire (Terumo Inc), directed by a 5 Fr multi-purpose catheter (Cordis) (Fig. 1A). All patients received 40 International Units/kg of Heparin intravenously prior to the dilatation. Angioplasty was performed for each lesion using the appropriate size balloon dilatation catheter (10% more than the diameter of the vein proximal to stenosis). The balloon was kept inflated in place for a period of one minute (Fig. 1B, 1C).

A completion angiogram was performed to evaluate the immediate result of the intervention (Fig. 1D). Immediate technical success was defined as residual stenosis less than 30% of the vessel diameter in relation to the normal vessel diameter distal to the stenosis and without major complications related to the procedure.<sup>(10,11)</sup>

The procedure caused tolerable pain and discomfort in 46 patients. Three patients experienced severe pain and were managed by administering 50 mg of phentanyl intravenously, under continuous vital signs monitoring as per our institution protocol. Forty-eight patients received treatment on outpatient basis, were monitored in our recovery unit for 6 hours following the procedure, and were then discharged without complications. One patient developed rupture of the vein at the site of angioplasty and was admitted to the hospital. Two patients developed small puncture site hematoma that was treated conservatively.

The patients were followed up at 6 and 12 months by clinical examination tailored to detect any signs and symptoms of venous outflow stenosis. Doppler ultrasound scanning was performed for all patients.

The angiographic and interventional procedures were performed in the interventional radiology section. The patients were followed up in the vascular surgery clinic, and Doppler ultrasound studies were performed in the vascular surgery department.

## Results

Technical success was encountered in 48 patients as documented on their completion fistulogram. Two patients developed small puncture site hematomas

**Table II:** Patency results among the study group

	<b>6 Months</b>	<b>12 Months</b>
Number of Patients	47	43
Patent Venous Outflow	39	23
Failure of Angioplasty	8	20
Primary Patency Rate	83%	53%

that were treated conservatively, and did not necessitate admission to the hospital. One patient developed rupture of the vein at the site of angioplasty and was admitted to the hospital for surgical management. This patient was discharged after 48 hours, and was considered as a failure of primary angioplasty (Table I).

On follow up, 39 patients remained asymptomatic at six months, and 23 patients at one year. These patients demonstrated patent outflow by Doppler ultrasound without significant stenosis (Table II).

Twenty patients developed recurrence of symptoms during the follow-up period. Doppler scanning done at that time revealed recurrent stenosis. Thirteen patients were treated successfully by a second angioplasty (11 patients) or stenting (2 patients), while the other 7 patients failed this further endovascular treatment and were therefore referred for surgery.

Six out of the total 49 patients died during the follow-up period, two of them in the first six months, due to causes not related to the procedure or access failure.

## Discussion

Over the years, surgically created arteriovenous fistulae have been accepted as efficient long term accesses for hemodialysis in end stage renal disease patients. A major cause of delayed failure in these accesses is stenosis affecting the venous side.<sup>(1,2)</sup> Other causes include arterial side stenosis, generalized hypotension, extrinsic compression, trauma, or infection.<sup>(1)</sup>

Venous outflow stenosis may present with a wide spectrum of symptoms including persistent edema of the limb, presence of a pulse without a thrill, inefficacious dialysis, increase in the venous pressure, or even complete thrombosis of the hemodialysis access.<sup>(4,9)</sup>

Early detection and treatment of venous stenosis prevents access thrombosis, and prolongs access patency.<sup>(6,7)</sup> In recent years, there has been increasing evidence in literature supporting the use of PTA as the primary method of treatment for dialysis access stenosis,<sup>(4,12)</sup> offering the patients a shorter stay in the

hospital, and acceptable success rates when compared with surgery, in addition to the opportunity to immediately use the same access for dialysis.<sup>(1)</sup>

Like other medical procedures, PTA can be associated with complications that can occur during or after the procedure. Major complications include venous rupture, arterial embolization, symptomatic pulmonary embolism, puncture site complications necessitating treatment, and bleeding. Minor complications include non-flow compromising small puncture site hematoma or pseudoaneurysm formation.<sup>(13)</sup>

In this study, we have included patients who presented with symptoms and signs of venous stenosis, in previously functioning, surgically created arteriovenous fistulae. Those patients who proved to have focal short segment venous outflow stenosis by Doppler ultrasound, and fistulogram, were treated with PTA, and were then followed up at six, and 12 months by clinical examination and Doppler ultrasound scanning.

Patients who had multiple venous stenosis or occlusion were treated primarily by PTA with or without stenting. Patients who failed this primary endovascular intervention or those who were having long segment venous stenosis, or had juxtastomotic stenosis were referred for surgical revision. All those patients were excluded from our study.

Our study showed a high technical success rate in treating short segment venous outflow stenosis. The follow up demonstrated high primary patency rates at six months (83%) and one year (53%).

Our study showed that the procedure is relatively safe with only one major complication (2%), and two minor complications (4%) encountered. Our results were consistent with the results of other studies in literature.<sup>(1,14)</sup>

## Conclusion

Percutaneous transluminal angioplasty is an effective, minimally invasive method for treatment of venous outflow stenosis in surgically created arteriovenous fistulae, with high technical success, acceptable one year primary patency, and relatively low complication rates.

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