Comparative outcome of patch angioplasty versus balloon angioplasty after surgical thrombectomy of thrombosed arteriovenous hemodialysis graft: 18-month results

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Background

Repeated interventions to keep the well-functioning dialysis vascular access represent the Achilles heel for hemodialysis patients. Thrombosed permanent dialysis access, either arteriovenous fistula or arteriovenous graft (AVG) remains one of the most common and debatable complications regarding frequency of occurrence and how to manage.

Objective

Our study aims to evaluate mid-term outcomes of surgical thrombectomy of clotted AVG with adjunctive venous outflow procedures mainly patch angioplasty versus balloon dilatation to restore their function regarding patency as primary endpoint and safety as secondary endpoint.

Patients and methods

Between May 2016 and April 2019, 96 of 125 patients with first-time thrombosed dialysis AVGs were prospectively evaluated after block randomization for surgical patch angioplasty (group A) versus balloon angioplasty (group B) for venous anastomotic side after surgical thrombectomy in four tertiary referral hospitals in Egypt.

Results

Over 18-month follow-up period of our enrolled patients, immediate technical success was 100% with regaining graft functionality in 100% of 45 patients in group A patients versus 89.6% (P=0.056) in group B with achieving optimum graft functionality in 100% of technically successful declotting procedures (43 patients) in group B. The primary patency at 6, 9, 12 and 18 months in group A was 66, 63.6, 52.3 and 31.8%, respectively, versus 48.8, 48.8, 37.2 and 18.6%, respectively, in group B. The secondary patency in group A at 6, 9, 12 and 18 months was 86.4, 100, 88.6 and 77.3%, respectively, versus 72.1, 90.7, 79.1 and 69.8%, respectively, that was not statistically significant except 12-month primary patency (P=0.014).

Conclusion

Our study found no statistically significant difference in 18-month outcomes between patients treated with surgical thrombectomy with patch angioplasty and surgical thrombectomy with balloon angioplasty for thrombosed AVGs regarding regaining functionality and patency, however patients treated with balloon angioplasty required more additional secondary interventions and most of them were to manage graft venous anastomotic site restenosis.

Keywords:
angioplasty, arteriovenous graft, thrombectomy thrombosis

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Introduction

Polytetrafluoroethylene (PTFE) synthetic grafts are commonly used as an alternative hemodialysis (HD) access to native arteriovenous fistula (AVF), it may be utilized as a secondary option in patients with exhausted access or as a primary option in patients with unsuitable native veins, those requiring urgent dialysis and cannot tolerate waiting for maturation of native AVF with bridging temporary catheter, elderly patients with limited life expectancy. One privilege of synthetic graft over the native fistula is the possibility to be utilized within 24 h to 15 days of implantation for dialysis according to its type, this allows patients to bypass the 45–60-day waiting period for native fistula to mature [1]. On the other side, lower survival and higher complication rates are considered the main drawbacks of this type of dialysis access. Lower survival rate is mostly due to stenosis and subsequent thrombosis [2]. Stenosis of synthetic dialysis graft occurs mostly at venous anastomosis or close to it due to secondary intimal hyperplasia caused by flow

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turbulence at the prosthesis-vein interface [3]. Once graft is thrombosed, access salvage procedure should be attempted as early as possible according to The National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines. It also states that thrombectomy can be effective after several days [4]. Owing to the debate concerning how to treat thrombosed dialysis access and when with the lack of published evidence, we conducted our study to evaluate the outcome of surgical thrombectomy with adjunctive venous anastomosis remodeling either by patch angioplasty or balloon angioplasty.

Patients and methods

Study design

Our study is a prospective randomized study conducted between May 2016 to April 2019 at four Tertiary Referral Hospitals in Egypt (Benha University Hospital, Ain Shams University Hospital, Nile Insurance Hospital and Ain Shams Specialized Hospital). After institutional review committee approved the study protocol, 96 of 125 patients who were admitted to vascular surgery department with first-time thrombosed arteriovenous graft (AVG) of multiple patterns were randomly divided into two groups using 1 : 1 block randomization method. All enrolled patients provided signed informed consent. Our inclusion criteria were all patients with recently thrombosed dialysis graft (1–15 days) and AVG implantation was done by the vascular surgeons of the registered hospitals. Exclusion criteria were patients who were operated upon for AVG implantation outside the registered hospitals, patients with previous graft interventions either surgical or endovascular procedure, patients with evidence of thrombophilia, persistent hypotension that mandates vasopressor drugs or intravenous fluid or blood transfusion with dialysis session, patients who developed heart failure on dialysis, patients with needle puncture site pseudoaneurysm or infection and lastly patients with evidence central venous obstruction diagnosed clinically or documented by computed tomography venography.

Patient selection

For this analysis we predefined two patient groups:

(1) Group A (n=48) surgical thrombectomy with adjunctive remodeling of venous anastomotic side with patch angioplasty.
(2) Group B (n=48) surgical thrombectomy with adjunctive remodeling of venous anastomotic side with balloon angioplasty.

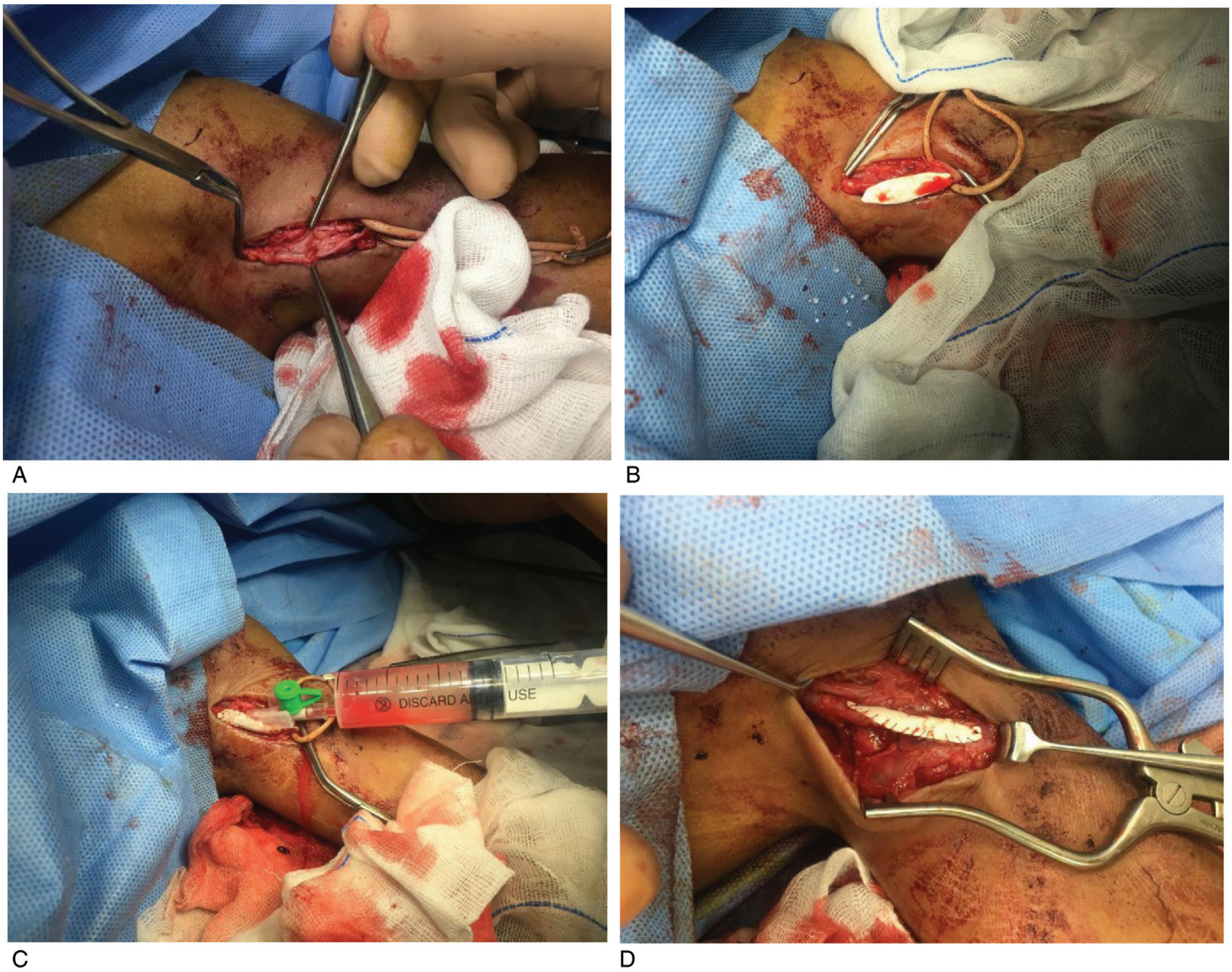
All patients referred to vascular surgery departments of study hospitals due to difficulties during HD or due to loss of thrill along the AVG. All patients were investigated by duplex ultrasound. After confirmation of AVG thrombosis the decision was surgical declotting of thrombosed grafts with investigating the venous anastomosis by conventional venography. All patients underwent graft surgical thrombectomy using Fogarty catheter.

Methods

All patients were known to have a straight pattern of brachio-axillary AVG or a loop pattern of arm or chest wall axillary–axillary 6 mm PTFE AVG with known end to side reconstruction of venous anastomosis. All procedures were performed under local anesthesia or ultrasound guided supraclavicular nerve block in supine position with patients arm in fully abduction position. For group A patients, surgical thrombectomy was performed through longitudinal graftotomy incision just 2 cm proximal and extended to the hood of venous anastomosis including at least 2 cm of apparently healthy distal native vein, we utilized the same skin incision used to implant the graft. Once patch angioplasty was decided after on-table completion venography (Fig. 1a), using Fogarty thrombectomy catheter 5 and 6 mm (Edwards Lifesciences LLC, Irvine, California, USA). After thrombectomy of AVG, regional heparinization together with diagnostic fistulogram were performed to evaluate arterial anastomosis and central veins (axillary vein, subclavian vein and innominate vein) for any stenosis or segmental occlusion (Fig. 1c). Remodeling of venous anastomosis and closure of graftotomy incision using PTFE patch with 5/0 or 6/0 polypropylene suture (Fig. 1d). Completion angiogram was performed through 16 F cannula inserted more proximally in graft body near arterial anastomotic site.

For group B patients, thrombectomy was performed through transverse graftotomy incision that located just 3 cm distal to the hood of arterial anastomosis in straight pattern of brachio-axillary AVG or at the apex of the loop pattern AVG (Fig. 3a) midway between arterial and venous anastomosis (Figs 3b and 4a). Following declotting (Fig. 3b) and regional heparinization of the thrombosed graft, fistulogram was accomplished through 6 or 8 F sheath evaluating both arterial and venous anastomosis side (Figs 2a and 3d and 4c). Over 0.035 hydrophilic standard terumo wire, balloon dilatation of venous anastomosis was performed gradually using Mustang high-pressure balloon (Boston Scientific, Natick, Massachusetts, USA) and Dorado high-

Figure 1



(a) Venous anastomosis longitudinal graftotomy. (b) Closure of venous outflow with polytetrafluoroethylene patch after thrombectomy. (c) Dye injection to confirm central venous system patency (d) patch angioplasty of venous anastomotic side.

pressure balloon (Bard Peripheral Vascular, Tempe, Arizona, USA) starting with 8 mm diameter initial dilatation and finally with 10 mm diameter balloon if there is residual stenosis (Figs 2b and c and 3e and f and 4d and e). Completion angiography was done to confirm no residual stenosis nor rupture of anastomotic suture line (Figs 2d and 3g and 4f). Closure of graftotomy incision with interrupted 5/0 or 6/0 polypropylene suture. Adjunctive graft body and inflow angioplasty was required some cases of both groups (Fig. 3h and i) utilizing Mustang 6 mm diameter high-pressure balloon (Boston Scientific).

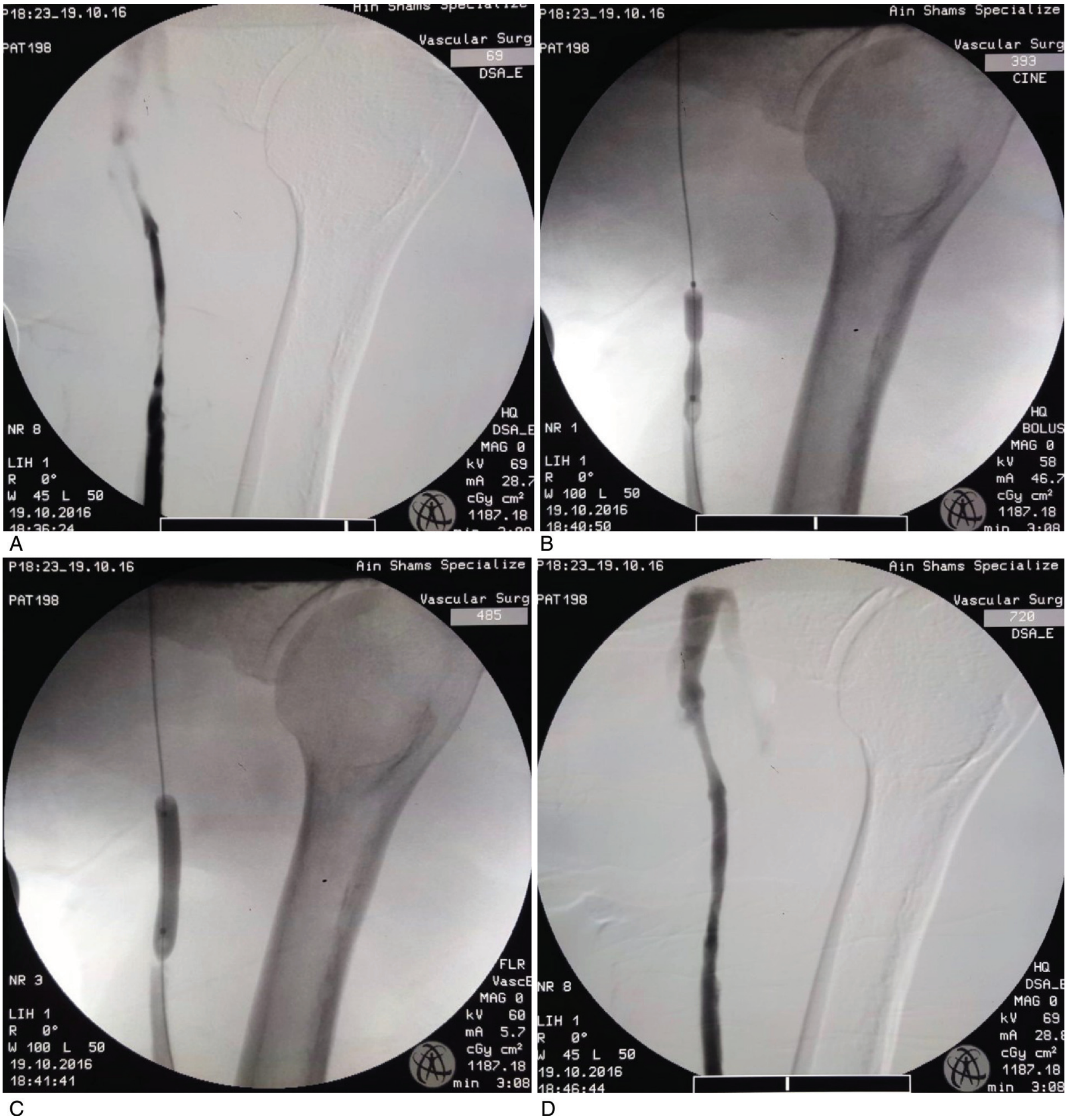
Follow-up

All patients were prescribed low molecular weight heparin in therapeutic renal adjusted dose for 14 days before shifting to oral anticoagulant therapy. One-day postoperative duplex ultrasound was done to ensure graft patency before discharge. All patients were allowed to use recanalized grafts for regular HD as early as possible to avoid temporary catheter complications. Follow-up visits were scheduled at 1, 3, 6, 12 and 18-month visit to evaluate graft patency and dialysis efficacy by palpable thrill and duplex surveillance, or urgent visits were arranged once graft functional problem was reported.

Definitions and study outcome measures

The primary endpoints of our study were postprocedural primary and secondary patency of declotted AVGs after treatment of venous anastomotic lesion of first-time thrombosed prosthetic HD grafts. The secondary endpoints were procedure-related complications and patient survival within 18 months after thrombectomy. According to the guideline published by the Society of Interventional Radiology [5] we defined procedural technical success as restoration of flow in the thrombosed dialysis graft with a palpable thrill along the course of AVG. Additionally, we included regaining grafts functionality for both group A and B and less than

Figure 2



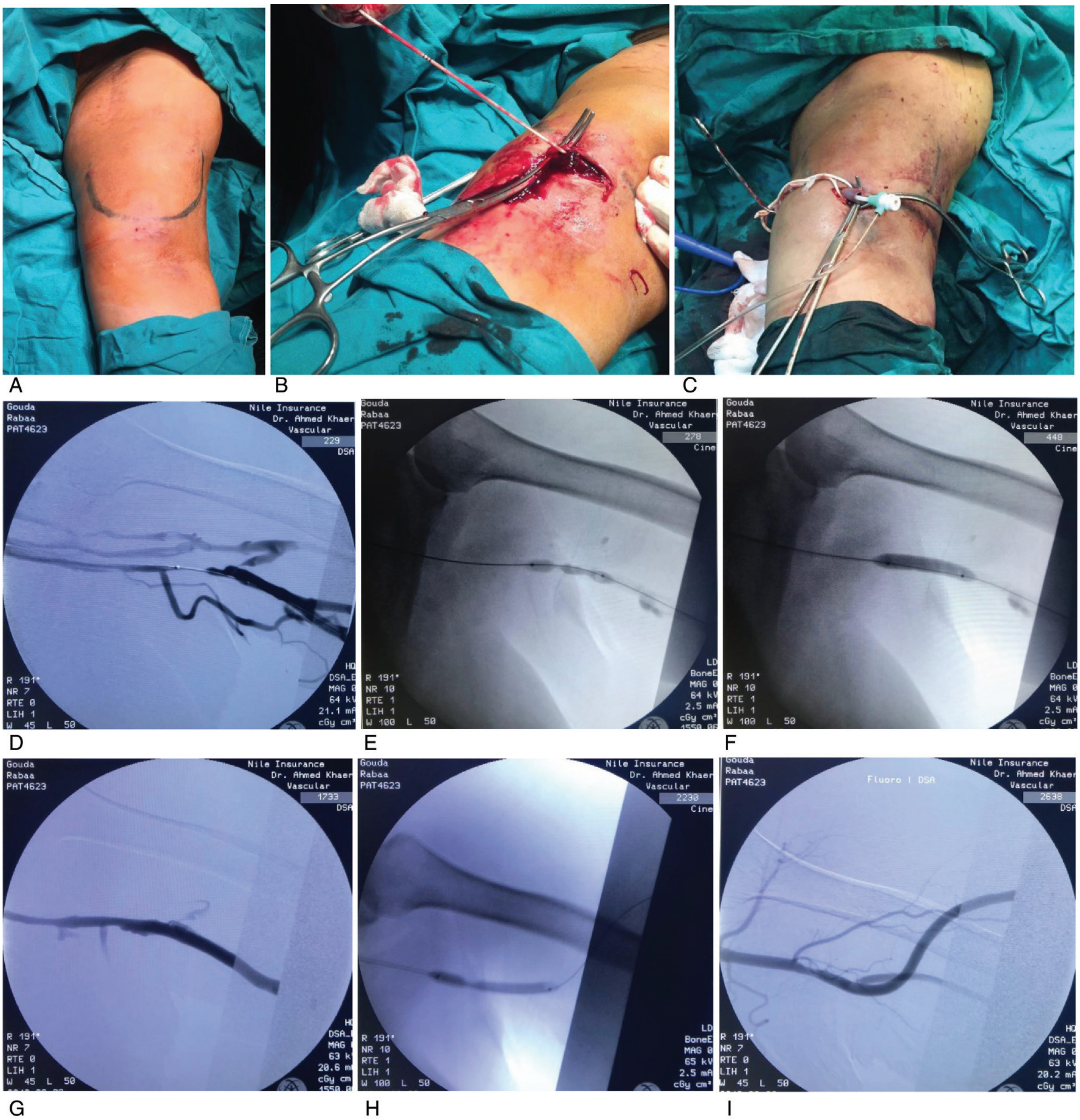
(a) Post-thrombectomy stenosis of venous (b) balloon angioplasty with 8 mm high pressure balloon anastomotic site and needle puncture site (c) balloon angioplasty with 10 mm high pressure balloon (d) completion angiogram with residual stenosis less than 30%.

a 30% residual diameter stenosis in group B (balloon angioplasty) as a criterion for technical success. Primary patency was defined as the time interval after the procedure until the next access thrombosis or first subsequent intervention. Postintervention secondary access patency was defined as the interval following the index surgical intervention until the access was surgically declotted, revised or abandoned of the access circuit. Graft functionality was defined as ability to deliver a flow rate of at least 350–400 ml/min without access recirculation to maintain treatment time of less than 4 h [6]. Major complications were defined as complications that required additional treatment or resulted in permanent sequelae or death. Minor complications were defined as periprocedural problems requiring no or nominal therapy with no sequelae [7].

Statistical analysis

We evaluated data for all endpoints in an intention-to-treat analysis. The initial data entry used Microsoft Excel (office 365) (2015 Microsoft, Redmond, USA) for logical proofreading and analysis. We expressed continuous data as mean±SD and compared continuous variables using two-sided Student's *t*-tests. We estimated primary and secondary patency

Figure 3



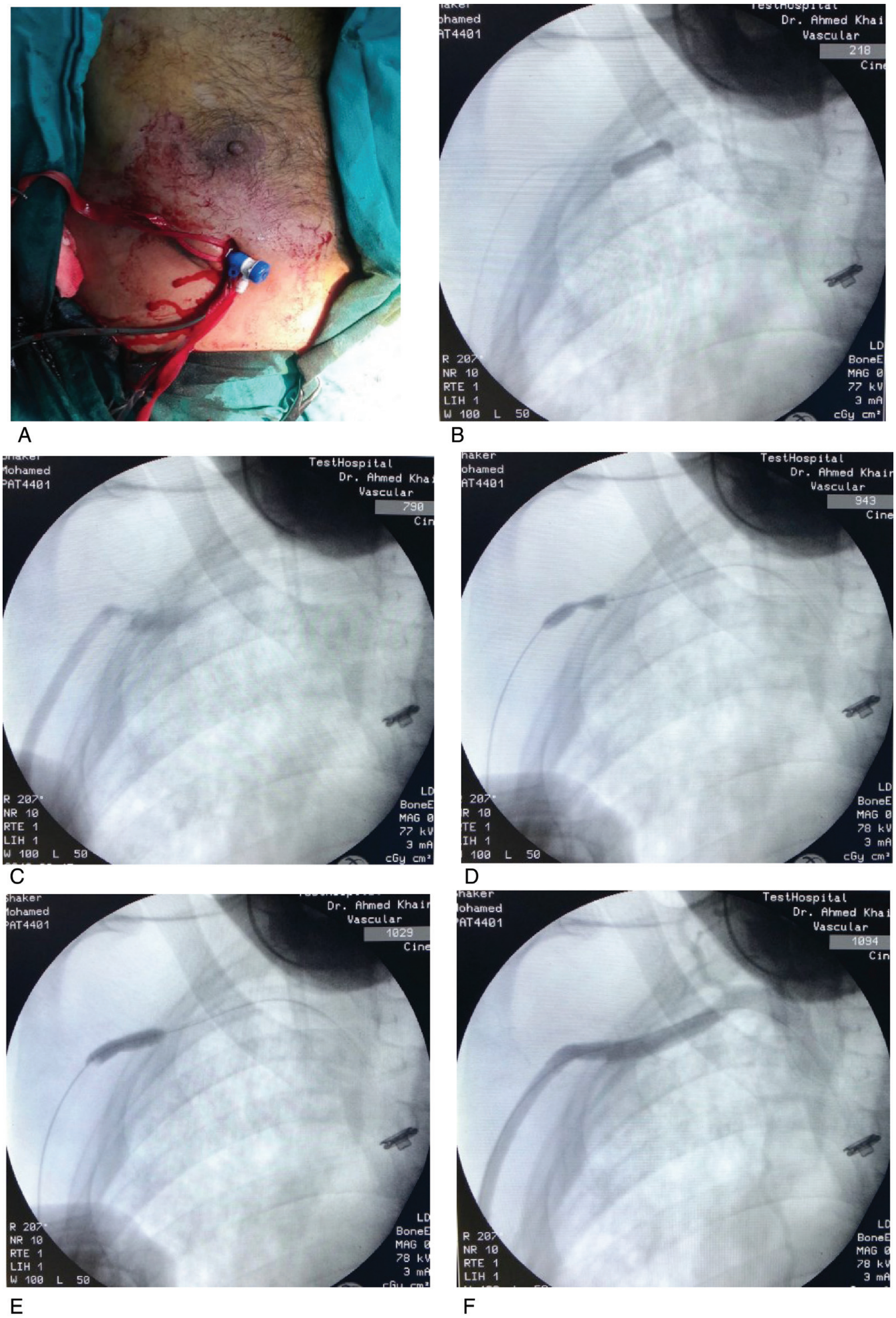
(a) Axillo-axillary arm loop arteriovenous graft (AVG) (b) thrombectomy with Fogarty catheter (c) sheath insertion through graftotomy incision (d) sever stenosis at AVG venous anastomotic (e) marked balloon waisting during angioplasty (f) successful angioplasty site. (g) Completion venography with no (h) balloon angioplasty of stenotic inflow (i) completion angiography with optimum residual significant stenosis lesion with axillary artery inflow through AVG.

using Kaplan–Meier method. We considered *P* value less than 0.05 to be statistically significant. Statistical analysis was performed by using IBM statistical package for the social sciences (SPSS) software (version 22 for Windows program package; SPSS Inc., Chicago, Illinois, USA).

Results

From 125 patients with first-time thrombosed AVG presented to the vascular surgery departments enrolled in our study only 96 patients (59 male patients 61.5% and 37 females 38.5%) with average age (49.27±7.67) (Table 1) and with various patterns of thrombosed AVG (arm straight brachio-axillary pattern in 70 (73%) patients, chest wall axillo-axillary loop graft in 13 (13.5%) patients and axillo-axillary arm loop pattern in 13 (13.5%) patients were eligible to our inclusion criteria (Table 2). Patients were randomly divided into two groups using 1 : 1 block randomization method. Group A (*n*=48) underwent surgical thrombectomy with adjunctive

Figure 4



(a) Transverse graftotomy at apex of loop (b) fluoroscopic guided thrombectomy using pattern arteriovenous graft with sheath 8 F through it. 6 mm Fogarty catheter. (c) Residual stenosis at venous anastomosis (d) sever waisting of 8 mm high pressure balloon (e) balloon angioplasty with 10 mm high pressure (f) completion angiogram with optimum outflow balloon.

remodeling of venous anastomotic side with patch angioplasty and group B (*n*=48) underwent surgical thrombectomy with adjunctive remodeling of venous anastomotic side with balloon angioplasty, patients' characteristics of both groups are shown in Table 2. All thrombosed AVG in both groups were found to have stenosis at venous anastomotic side that was suggested to be the main etiology of graft failure. The average number of previously done dialysis access in group A was three with average years on HD 4.5 versus 4 (*P*=0.56) and 5.5 (*P*=0.30), respectively, in group B (Figs 5 and 6). The mean duration of access thrombosis in days was 4.5 (2–8) in group A versus 4 (2–6.75) (*P*=0.55; Fig. 7). Immediate technical success after surgical declotting was 100% in group A patients versus 89.6% in group B with required adjunctive procedure in 6.3% in group A versus 10.4% in group B (*P*=0.014). Three (6.3%) patients of group A required adjunctive central vein balloon angioplasty due to axillary vein, subclavian vein and innominate vein significant stenosis and they were excluded from our study follow-up protocol. In addition to one (2.1%) patient whose AVG was ligated postoperatively due to procedure related infection. In group B, five (10.4%) patients showed residual outflow significant stenosis that was not resolved by repeated balloon angioplasty and required bailout stenting at graft outflow anastomosis. Those patients were excluded from our follow-up protocol. Adjunctive inflow arterial anastomosis angioplasty was done in five (10.4%) patients in group A versus eight (16.7%) patients in group B (*P*=0.35). Intragraft stenosis was detected in three (6.25%) patients in group B (*P*=0.07). Regarding declotted AVG functionality, all patients of both groups showed successful postprocedure dialysis session with graft flow rate more than 400 ml/min proved by duplex. Primary patency at 6, 9, 12 and 18 months in group A was 66, 63.6, 52.3 and 31.8%, respectively, versus 48.8, 48.8, 37.2 and 18.6%, respectively, in group B with nonstatistically significant *P* value except for 12-month primary patency (*P*=0.014; Fig. 8) (Table 3). Secondary patency in group A at 6, 9, 12 and 18 months was 86.4, 100, 88.6 and 77.3%, respectively, versus 72.1, 90.7, 79.1 and 69.8%, respectively, in group B with nonstatistically

Table 1 Age and sex distribution of the studied group

	The studied group (96) [*N* (%)]
Sex	
Male	59 (61.5)
Female	37 (38.5)
Age [mean±SD (range)] (years)	49.27±7.67 (35–69)

Table 2 Patients characteristics of the studied groups

Angioplasty	Patch (48) [*N* (%)]	Balloon (48) [*N* (%)]	*P* value
Sex			
Male	30 (62.5)	29 (60.4)	0.83
Female	18 (37.5)	19 (39.6)	
Age (mean±SD) (years)	49.13±8.85	49.42±6.37	0.85
DM	0	48 (100)	<0.001**
HTN	28 (58.3)	24 (50.0)	0.41
IHD	20 (41.7)	21 (43.8)	0.84
Smoking	22 (45.8)	17 (35.4)	0.30
Hemodialysis [median (IQR)] (years)	4.5 (3.25–6)	5.5 (4–6)	0.30
Type of access			
Axillo-axillary	11 (22.9)	14 (29.2)	0.49
Brachio-axillary	37 (77.1)	34 (70.8)	
Pattern of access			
Arm loop	7 (14.6)	6 (12.5)	0.66
Arm straight	36 (75.0)	34 (70.8)	
Chest wall loop	5 (10.4)	8 (16.7)	
Technical success			
Yes	48 (100)	43 (89.6)	0.056
No	0	5 (10.4)	
Number of previously done access [median (IQR)]	3 (2–4)	4 (2–5)	0.056
Duration of access/month [median (IQR)]	14.5 (12–17.75)	15.5 (13.25–17)	0.55
Adjunctive procedure			
Subclavian vein angioplasty	3 (6.2)	0	0.014*
Stenting	0	5 (10.4)	
–	45 (93.8)	43 (89.6)	
Immediate postprocedure regaining graft functionality	45 (93.8)	43 (89.6)	0.71
Infection			
Yes	1 (2.1)	0	0.71
Excluded	3 (6.2)	5 (10.4)	
–	44 (91.7)	43 (89.6)	
Duration of thrombosis [median (IQR)]	4.5 (2–8)	4 (2–6.75)	0.55
Number of add procedure [median (IQR)]	1 (0–1.75)	2 (1–2)	0.007**

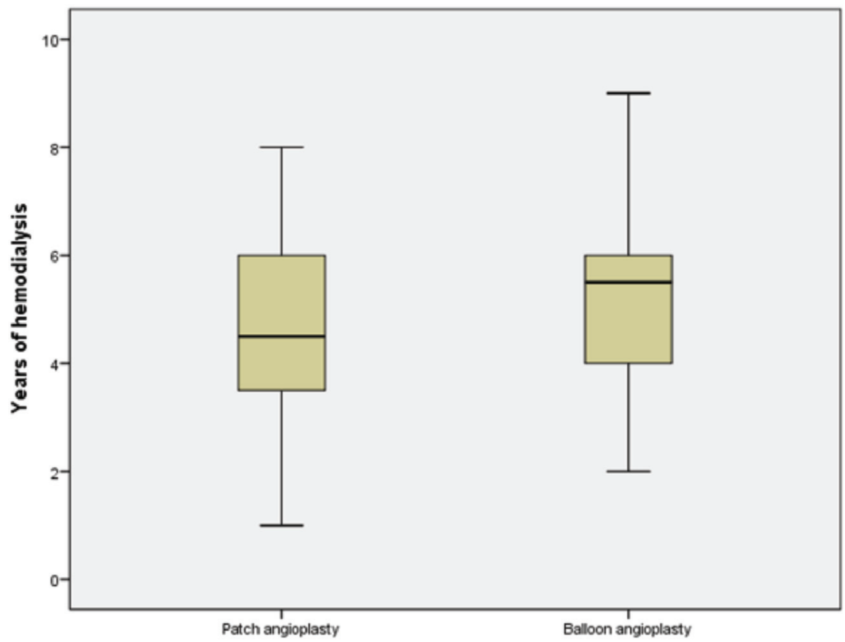
*$P<0.05$ is statistically significant. **$P<0.001$ is highly significant.

Table 3 Results of the studied groups

Angioplasty	Patch (44) [*N* (%)]	Balloon (43) [*N* (%)]	*Z*	*P* value
Six months follow-up				
Primary patency	29 (66.0)	21 (48.8)	1.62	0.11
Secondary patency	38 (86.4)	31 (72.1)	1.65	0.10
Malfunction	2 (4.5)	4 (9.3)	0.88	0.38
Thrombosed	4 (9.1)	8 (18.6)	1.28	0.20
Nine months follow-up				
Primary patency	28 (63.6)	21 (48.8)	1.39	1.65
Secondary patency	44 (100)	39 (90.7)	2.07	0.04*
Malfunction	0	3 (7.0)	1.79	0.07
Thrombosed	0	1 (2.3)	1.01	0.31
Twelve months follow-up				
Primary patency	23 (63.6)	16 (37.2)	2.46	0.014*
Secondary patency	39 (88.6)	34 (79.1)	1.21	0.23
Malfunction	0	1 (2.3)	1.01	0.31
Thrombosed	2 (4.5)	4 (9.3)	0.88	0.38
Ligated	2 (4.5)	3 (7.0)	0.50	0.62
Died	1 (2.3)	1 (2.3)	0.0	1.0
Eighteen months follow-up				
Primary patency	14 (31.8)	8 (18.6)	1.42	0.16
Secondary patency	34 (77.3)	30 (69.8)	0.79	0.43
Thrombosed	5 (11.4)	8 (18.6)	0.94	0.35
Ligated	2 (4.5)	4 (9.3)	0.88	0.38
Died	3 (6.8)	1 (2.3)	1.0	0.32
Mortality				
Alive	41 (83.2)	42 (87.7)	0.59	0.56
Died	3 (6.8)	1 (2.3)	1.0	0.32

Z test of proportion. **P* value $<$0.05 is statistically significant. *P* value $<$0.001is highly significant.

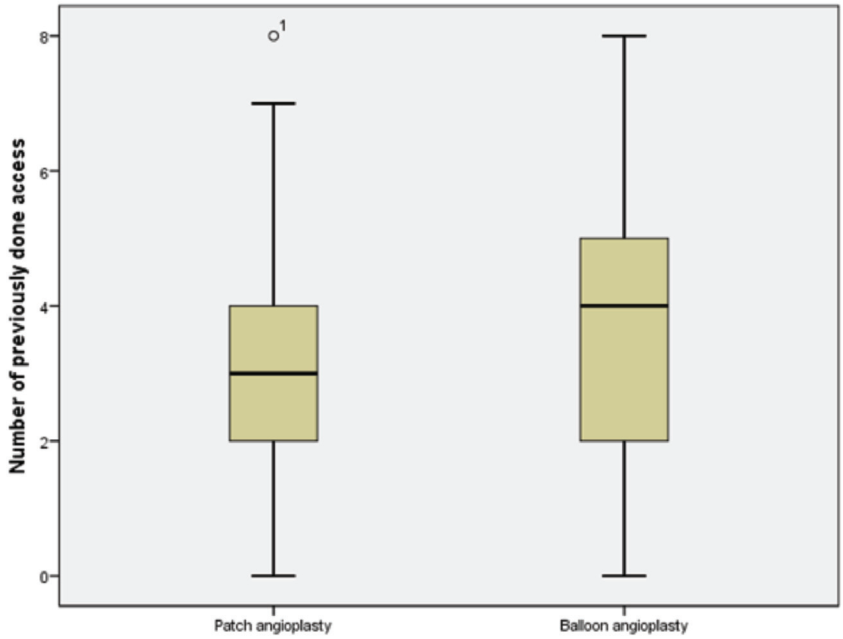
Figure 5



Average years of hemodialysis in patients treated with patch angioplasty versus balloon angioplasty.

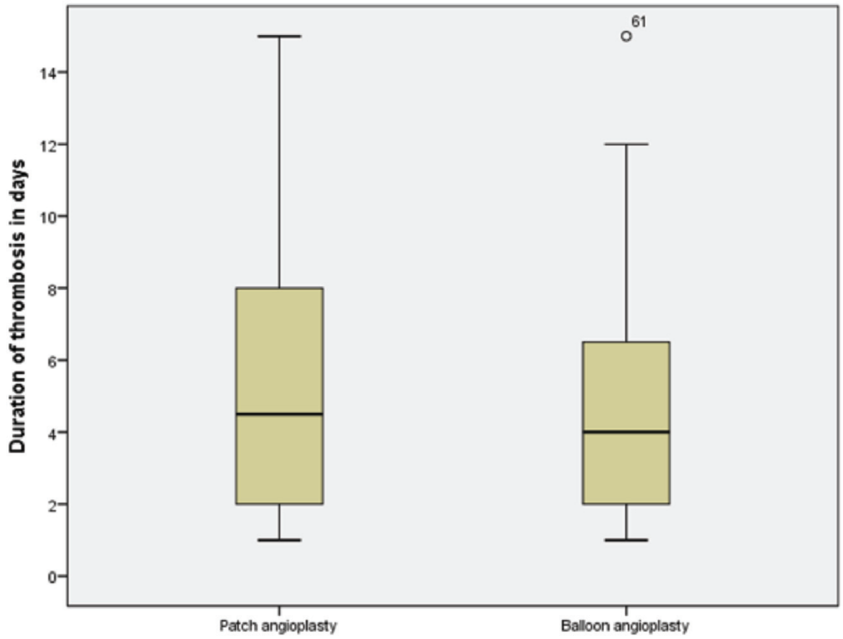
significant *P* value except for 9-month secondary patency (*P*=0.04; Fig. 9). Through 18-month follow-up period six (6.9%) AVGs were ligated; two in group A and four in group B (Table 3). Puncture site related infection was the cause of ligation in four of six (66.7%) AVGs while the other two grafts were ligated after renal transplantation. Four (4.6%) patients died during

Figure 6



Number of previous dialysis access done in patients treated with patch angioplasty versus balloon angioplasty.

Figure 7



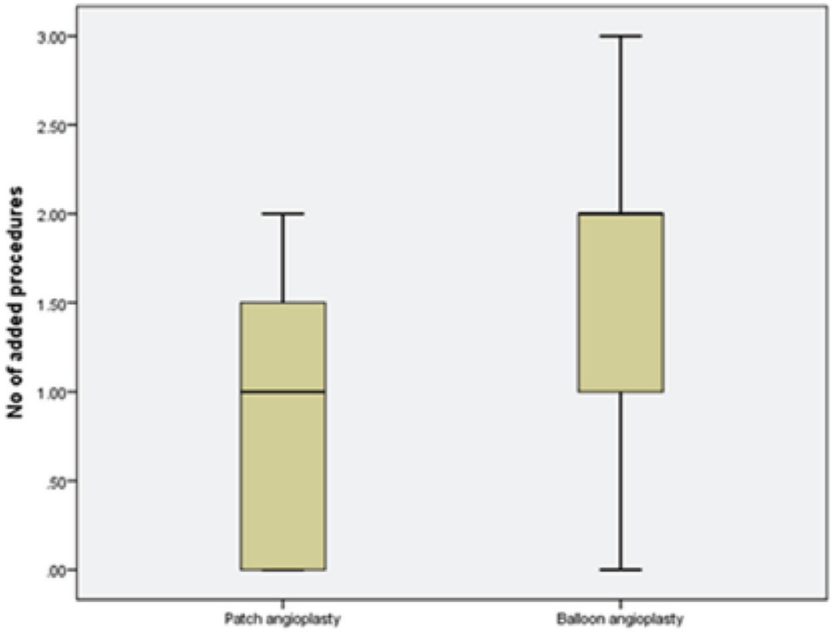
Average thrombosis duration in days in patients treated with patch angioplasty versus balloon angioplasty.

follow-up due to cardiovascular comorbidities and dialysis related problems; three (6.8%) of which in group A and one (2.3%) in group B. Totally, 39 additional secondary procedures were performed to preserve graft patency in group A, central vein angioplasty was the most secondary procedure performed (n=21, 53.8%) with median IQR 1. While in group B, 59 secondary interventions were performed in form of outflow procedures including repeated angioplasty, stenting where patch angioplasty was the most commonly done (n=38, 64.4%) with median IQR 2 (P=0.007; Fig. 10).

Discussion

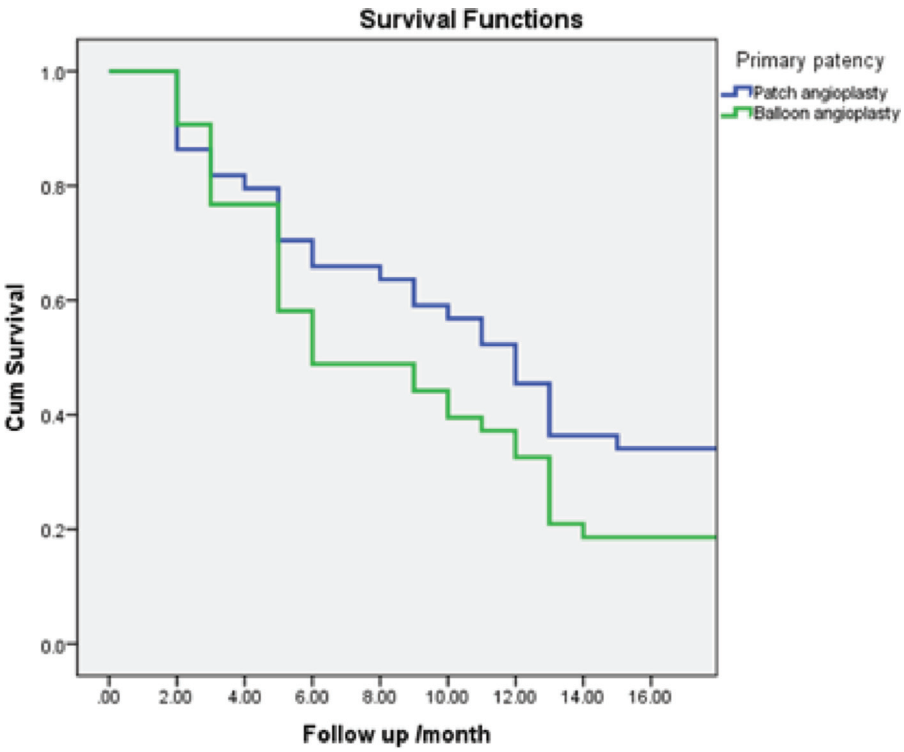
HD vascular access thrombosis is one of the most frequent complications encountered by vascular access surgeons during everyday practice. It represents a

Figure 8



Average thrombosis duration in days in patients treated with patch angioplasty versus balloon angioplasty.

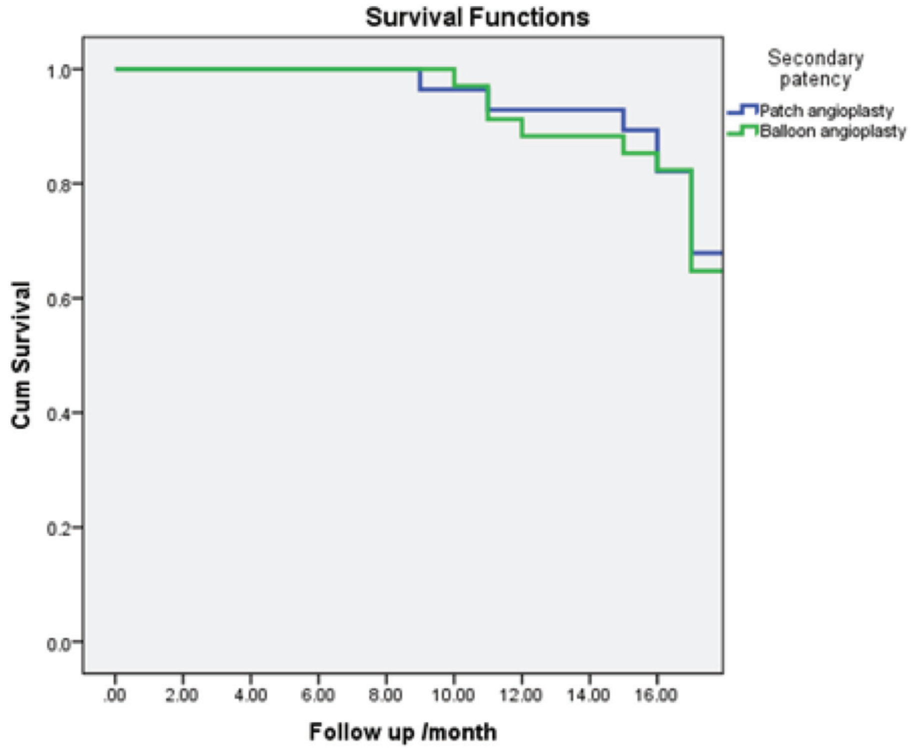
Figure 9



Kaplan–Meire survival curve for primary patency of patch angioplasty versus balloon angioplasty..

debatable issue for surgeons regarding how to manage either with surgical declotting or creation of a new vascular access. As for the patients, it is considered a major burden to establish a temporary access for dialysis until construction of a new access, which is difficult in most of patients especially those with AVG that indicates exhaustion of most native veins. Therefore, salvage of thrombosed vascular access is also important and should be attempted due to the limited native viable veins and arteries allowing creation of new vascular access. AVG which is an artificial vascular prosthesis is used as HD vascular access in the case of failure or

Figure 10



Kaplan–Meire survival curve for secondary patency of patch angioplasty versus balloon angioplasty.

inability to create native AVF, their crushing disadvantage is their propensity for venous outflow stenosis caused by endothelial hyperplasia leading to thrombosis and graft failure [8]. Neointimal hyperplasia formation is the main pathogenesis that results in progressive luminal narrowing causing thrombosis and graft failure, it mostly occurs at venous anastomosis (58–90%) [9]. Inflow arterial anastomotic site and outflow central veins stenosis are also another anatomical location for this culprit pathology, unlike the main pathology of outflow and inflow anastomotic sites, stenosis occurs within the main graft body remote from anastomotic sites is related to the development of peri-graft scar and fibroblastic in growth through needle puncture tracts at the access cannulation sites [10]. Unlike the USA, in European countries, AVG is used as the last preference for providing access to HD before central venous catheter [8]. AVG function is limited; the primary patency at 6 months is 58% and at 18 months 33%, secondary patency is 76 and 55%, respectively [11]. The secondary patency of the AVG is usually 50% at 3 years and is typically associated with repeated additional secondary interventions to keep it patent [12]. Stenoses in venous anastomotic site of graft (VAG) can be surgically and endovascularly treated. According to the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines AVG stenoses greater than 50% are indicated for angioplasty or surgery [13]. Surgical therapy is open surgical revision-VAG stenosis either by patch angioplasty to widen the graft outflow or with jump graft to distal healthy venous segment. Percutaneous interventions are less invasive than surgery. The predominant endovascular methods used are stenosis angioplasty percutaneous transluminal angioplasty (PTA) [14] and angioplasty with stenting (PTA+stent) [15]. Surgery should be reserved for patients in whom balloon angioplasty has failed and stent implantation is indicated. After three angioplasties, the patient should be offered surgical correction as an option [16]. The aim of our study is to evaluate the outcome of surgically declotted AVG with remodeling of venous anastomotic site either surgically with patch angioplasty or balloon angioplasty, regarding regaining graft functionality and patency. Regarding clinical characteristics of patients treated with the surgical and hybrid procedures including age, sex, risk factors and duration on HD, no significant differences were found between the two groups, except for diabetes mellitus, hypertension was the dominant risk factor in 52 (54.1%) patients of both groups. flow arteries were mostly brachial artery in 71 (74%) patients and the outflow veins were axillary vein in all patients (100%). Regarding the index procedure characteristics including type, pattern of dialysis access and functionality of index procedure were comparable between both groups of our study. Ko *et al.* [17] compared outcomes of hybrid and surgical correction for de novo AVG occlusion their patients and procedure characteristics are comparable except for age, hypertension was the dominant risk factor in overall 49 (83.1%) patients. The outflow vein was the basilic vein in their study. Kao *et al.* [18] study reported that the two groups (balloon angioplasty group and surgical revision group) were similar in age, sex distribution, and medical comorbidity, hypertension was the dominant risk factor in both groups 155 (53.1%) patients. The pattern of declotted AVG in our study 13 (13.5%) arm loop, 70 (73%) arm straight and 13 (13.5%) chest wall. In Ko *et al.* [17] study forearm loop graft was the dominant pattern 54 (91.5%) and upper arm straight graft five (8.5%). Our study technical success and regaining graft functionality were comparable in both groups with nonstatistically significant difference in both primary and secondary patency except for 12-month primary patency and 9-month secondary patency. The Kaplan–Meier estimates of 12-month primary patency rates were 63.6% in the patch angioplasty group and 37.2% in the hybrid group. Ko *et al.* [17] 12-month primary patency were comparable to our results, their 12-month primary patency rates were 47 and 30% but were not different between the hybrid and surgery groups (P=0.73). This may be explained by their small number of the studied patients (59 patients). Ko [16] compared the outcome of four adjunctive treatment modalities after surgical declotting of thrombosed AVG. Compared to our study and according to Kaplan–Meier analysis, the survival curve for primary patency in the group treated with thrombectomy and intraoperative angioplasty, group treated with thrombectomy and sequential angioplasty and group treated with thrombectomy and patch angioplasty did not statistically differ in graft patency. Kao *et al.* [18] compared balloon angioplasty versus surgical revision for thrombosed dialysis graft outlet stenosis after thrombectomy in 289 thrombosed graft and their findings regarding primary patency showed no difference between both groups. Dapunt *et al.* [19] reported 1 week, 1 month, 1 year and 15 months. patency rates of 95, 72, 31 and 27%, respectively, for 22 PTA patients and 78, 64, 19 and 19%, respectively, for 22 surgical patients with no significant difference between both groups. The overall infection rate was three of 44 (6.8%) patients in group A versus two of 43 (4.6%) patients. The cause of infection was mainly puncture site infection except one patient in group A was infected immediately postoperative. Our study showed that surgical revision allows direct evaluation of the lesion and precise anatomic correction of the outlet stricture, but balloon angioplasty can offer more therapeutic options. According to our findings and the comparative results of this study, the surgical revision group apparently exhibited a higher graft survival, although the difference was not statistically significant. Intraoperative adjuvant angioplasty for thrombosed grafts in a single procedure is simpler and faster but associated with a highly statistically significant number of additional secondary interventions mainly on graft outlet due to restenosis. It has been recently shown that utilization of stent grafts to treat VAG of HD access appears to provide longer patency when compared with PTA alone [15]. The stent is coated with ePTFE inside and this material is identical to material from which AVGs are manufactured. This endovascular approach converts the initial surgical end-to-side venous anastomosis into an end-to-end anastomosis providing more laminar in line flow [20]. Graft outlet stenosis was found in all studied patients of both groups in association with other different locations like central venous outflow, puncture site and graft inflow, these finding may necessitate using intraoperative fistulogram to identify possible graft stenotic sites and may indicate that surgical thrombectomy alone does not ensure the optimum outcome in dialysis graft thrombosis.

Conclusion

Our study found no statistically significant difference in mid-term outcomes between patients treated with surgical thrombectomy with patch angioplasty and surgical thrombectomy with balloon angioplasty for thrombosed AVGs regarding regaining functionality and patency, however patients treated with balloon angioplasty required more additional secondary interventions and most of them were to manage graft venous anastomotic site restenosis. This may encourage future utilization of stent graft to decrease restenosis rate but also will be associated with increase procedure expenses.

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Conflicts of interest

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