Research Article

Arteriovenous Grafts Thrombectomy Salvage Procedures

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Abstract
Objective: Arteriovenous fistula (AVF) is the access of choice for hemodialysis. The thrombosis of a definitive access for hemodialysis is an acute event that can interrupt dialysis treatment. The management of AVF thrombosis is usually the implantation of a catheter until the creation of a new access; causing depleting the patient's vascular bed. We aimed to evaluate the efficacy of open and Angio-jet mechanical thromboectomy for salvage of failed or failing synthetic arteriovenous grafts (AVGs). **Materials and Methods:** 90 thromboectomy procedures were done for AVGs from January 2008 to January 2012. Surgical thromboectomy was done for 60 cases and the other 30 were treated by endovascular mechanical thromboectomy using Angio-jet machine. We classified our studied patients into two groups; **Group A** (underwent surgical thromboectomy) and **Group B** (underwent endovascular thromboectomy). **Results:** 73 of the treated arteriovenous grafts (AVG) were completely thrombosed (failed accesses). Complementary angioplasty carried on for 66 cases (73.3%). 30 of these 66-angioplasty group required stenting of the underlying stenosis. Primary technique success was 95% (57/60) and 90.0% (27/30) for surgical and endovascular techniques respectively. Primary patency rate follows up for one year showed no significant difference for both groups. No significant difference in the complications rates between both techniques. The rate of restenosis and re-intervention of the grafts and venous conduits is same in both stented and non-stent groups. **Conclusion:** No superiority of surgical technique over the endovascular one in terms of the primary technical success and for the mid-term patency rate. The endovascular technique could be preferred as the incidence of hematoma development was less and no incision was needed. Primary stenting of underlying venous stenosis is not recommended except in failure achievement of good venous outflow after angioplasty or at recurrent stenosis after the primary intervention.
Keywords: ArterioVenous Grafts, Thromboectomy, Endovascular Techniques, Angioplasty.

Introduction
Arteriovenous (AV) access is a field in vascular interventional surgery that has undergone much evolution. Arteriovenous fistula (AVF) is the access of choice for hemodialysis. It has lower rates of infectious and noninfectious complications and also lower costs of treatment compared to grafts and central catheters[1]. One of the acute events that can interrupt the dialytic treatment is thrombosis of the hemodialysis vascular access; be it a fistula or graft. Historically, treatment of access thrombosis involved abandonment of the access with placement of a new access in a different anatomical location. This approach, however, quickly exhausts venous sites for haemo-dialysis[2,3]. The presence of venous stenosis due to intimal hyperplasia causing low flow is the major cause of AVF thrombosis[4,5]. Both surgical and percutaneous methods have been developed to salvage thrombosed AV accesses[6]. Critical steps in

treatment of a thrombosed AV access include the following; removal of the thrombus from the access, fistulography to identify the cause for access failure and correction of the underlying access of venous outflow stenosis. Because there are few centers with immediate access to fluoroscopy and trained personnel for the treatment of AVF thrombosis; the current management of AVF thrombosis is usually the implantation of a central catheter until the creation of a new access. This current practice causing depleting the patient's vascular bed and in addition seems to be costlier to the health care system due to a greater need for intervention and hospitalization in patients with catheters[7]. The aim of our study was to evaluate the efficacy of

open and Angio-jet mechanical thromboectomy for salvage of failed or failing synthetic arteriovenous grafts (AVGs).

Material and Methods

Study Population and Protocol:

Data were collected from files of the patients in a retrospective randomized manner. 142 Arteriovenous grafts (AVG) were done from 2008-2012; 90 of them developed thrombosis either partial or complete. The thrombosed AVGs were picked up by dialysis center in Dr. Erfan and Bagedo General Hospital. Diagnosis of both failing and failed grafts was done on clinical basis and duplex examination.

In the present study; 90 thromboectomy procedures were done for AVGs from January 2008 to January 2012. Surgical thromboectomy was done for 60 cases and the other 30 were treated by endovascular mechanical thrombo-ectomy using Angio-jet machine. Therefore, we classified our studied patients into two groups; **Group A** (underwent surgical thromboectomy) and **Group B** (underwent endovascular thromboectomy).

The clinical parameters for failing AVG include the followings; pulsating graft with failure to detect thrill or bruit, increase the venous pressure during dialysis, swelling of the arm, pain at the site of needles puncture and prolonged time of hemostasis a needle puncture site.

Duplex examinations were done for all these failing grafts. If partial thrombosis detected at duplex examination, these patients were included at this study. Complete absence of thrill and the pulse associated with also failure of Cannulation of the graft indicates complete thrombosis and duplex examination confirms the clinical diagnosis.

Inclusion Criteria includes failing partial thrombosed and failed completely thrombosed grafts within one week from the time of occlusion. All included patients underwent thromboectomy either surgical or percutaneous thromboectomy, completion angiography with venoplasty or graftoplasty with or without stenting for the underlying stenotic lesions.

Endovascular Thromboectomy Technique:

Under local anesthesia direct puncture of the graft and short 6F sheath was inserted. 0.35 treumo wire and over it AVX catheter of angio-jet was passed into the graft. Mechanical thromboectomy was carried on with maximum 300 seconds duration. Double 6F sheaths cannulation was done in loop grafts for the venous and arterial arms. Angiography was done and any residual thrombus was detected, another session of thromboectomy was done till complete resolution of the thrombus. Angioplasty with or without stenting for any significant stenosis was done at the same session (Figures 1).

Surgical Thromboectomy Technique:

Under local anesthesia and intravenous sedation, the surgical thrombectomy was performed in the operative room by an experienced vascular surgeon. The surgical technique consisted of milking the thrombus from the thrombosed access (manual clot removal) adapted for prosthetic grafts, as well as fistulas. Culprit lesions were identified by exploring venous anastomosis site. A fistulogram was performed when technically feasible to confirm the completion of thrombectomy and to find a cause of access failure. Then culprit lesions were corrected surgically by patch angioplasty and jump graft. The treating nephrologist and the vascular surgeon both monitored the access during follow-up. Nephrologists carefully follow-up the patients with clinical examination as well as flow measurement during the dialysis session (Figures 2).

Follow-Up:

The studied patients were evaluated and followed up for one-year post intervention.

Results

Baseline Characteristics:

In the period from January 2008 to January 2012; 90 patients underwent thromboectomy procedures for AVGs. Table 1 showed demographic Features of the studied patients in **group A** (underwent surgical thromboectomy) and **group B** (underwent endovascular thromboectomy). Sixty and 30 patients were included in groups A and B, respectively. No significant difference in demographic features between both groups (table 1).

73 out of 90 arteriovenous grafts (AVG) had complete thrombosis (failed accesses) and the

remaining 17 had partial Thrombosis (failing grafts). Primary technique success was 95% (57/60) and 90.0% (27/30) for surgical and endovascular techniques, respectively. Complementary angioplasty carried on for 66 cases (73.3%). 30 of these 66-angioplasty group required stenting of the underlying stenosis. Venoplasty of the underlying stenosis at the anastomotic site or grafts was 75% in both groups A and B, respectively (43/57 & 20/27). Deployment of self-expandable stents was needed in 35.7% in both groups (Table 1).

Primary latency analysis:
The primary patency rate of the accesses in one year follow up was 71% and 74% in group A & B, respectively. Of the 57 fistulas, 41 presented primary patency outcome in group A and 20 out of 27 presented primary patency outcome in group B (Figure 3).

Secondary patency analysis:
During one year follow up, secondary patency rate of the accesses in both groups A & B was 87.7% & 92.5%, respectively. Of the 57 fistulas, 50 presented secondary patency outcome in group A and 25 out of 27 presented secondary patency outcome in group B (Figure 3).

Complications:
The incidence of complications including infections & hematoma was higher in group A (8.3%, 5/60) than group B (3.33%, 1/30) (Figure 3). The rate of restenosis and re-intervention of the grafts and venous conduits is same in both stented and non-stent groups.

Table 1: Demographic Features of studied patients.

Demographic Features	Group A (N: 60)	Group B (N: 30)
Age (ys)	64±3	62±3
Gender (male)	43 (71.6%)	21 (70%)
Diabetes	45 (75%)	22 (73.3%)
Hypertension	51 (81%)	26 (86.6%)
Ischemic Heart Disease	22 (36.6%)	11 (36.6%)

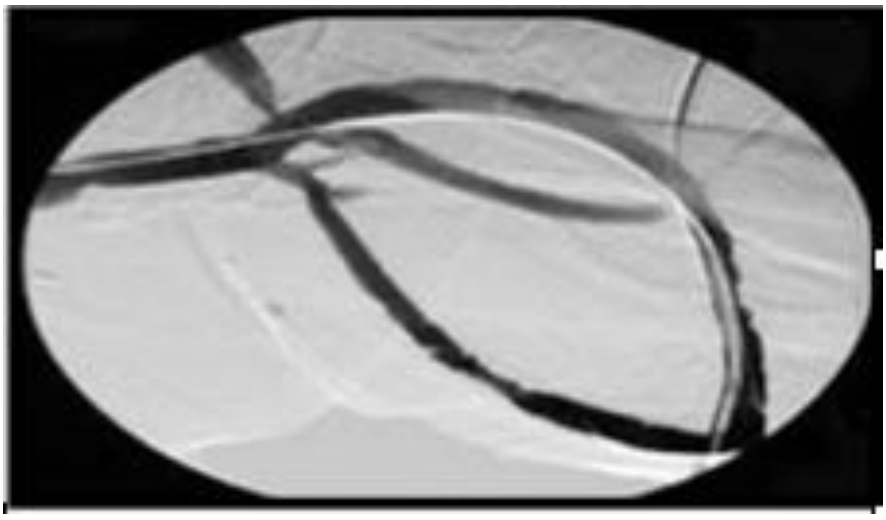

Figure 1: Endovascular treatment (Angio-jet) of loop.

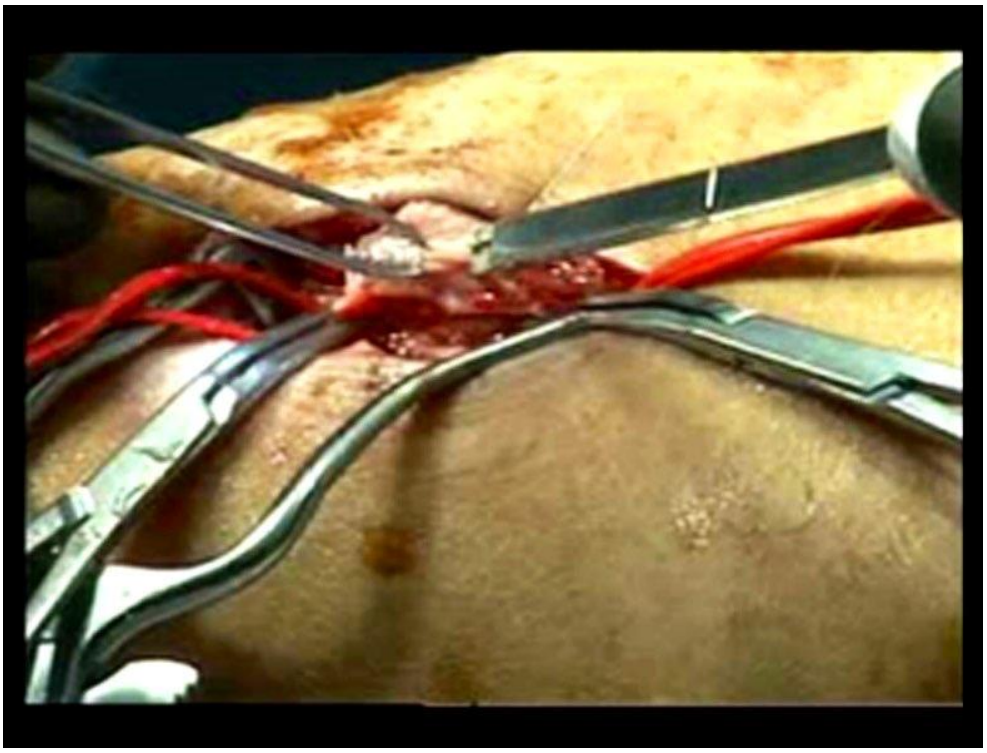

Figure 2: Surgical thromboectomy of straight graft

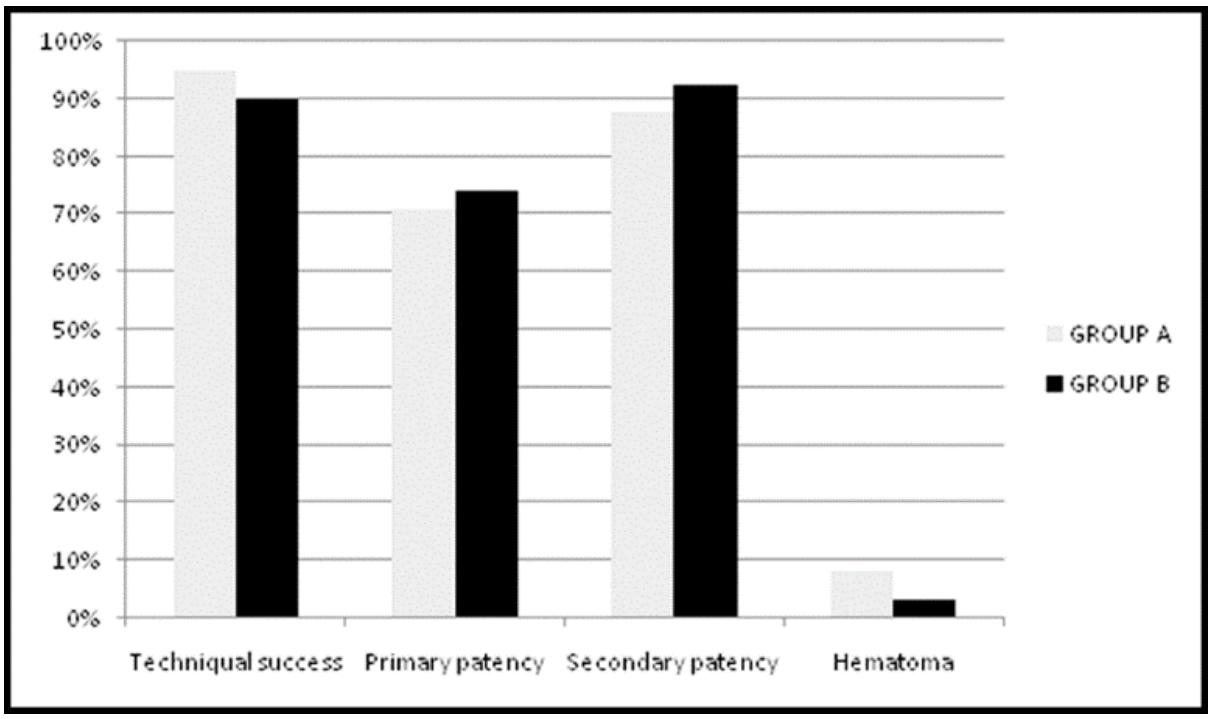

Figure 3: Technical success, primary patency, secondary patency and hematoma as a complication in both groups (Group A and Group B).

Discussion

Hemodialysis accesses salvage (dysfunction) can be managed by many techniques include surgical thrombectomy, endovascular thrombectomy associated with angioplasty of stenosis with or without thrombolytics and the use of specific devices for thrombus aspiration and lysis of clots (Angiojet, Boston Scientific, USA/ Arrow-Terotola, Arrow Medical, England/Aspirex, Straub Medical, Switzerland)[1]. These management techniques for salvage of failed or failing synthetic arteriovenous grafts (AVGs) leading to less missed dialysis sessions and less need for hospitalization, provided that the necessary structure and trained staff are in place.

In our study, we used the surgical and endovascular techniques to manage hemodialysis access salvage. The success rates were 95% (57/60) and 90.0% (27/30) for surgical and endovascular techniques, respectively. This result concordant with other studies[8-10].

National Kidney Foundation-Kidney Dialysis Outcomes Quality Initiative (NKF-KDOQI); Vascular Access Work Group 2006 stated that almost all thrombosis are related to venous stenosis and that these should be treated in order to avoid early recurrence[1]. In the most published case series, only 1% of thrombosis were not associated with any angiographic findings and only 3% were not related to stenosis[9,11]. So we can stated that the correction of venous stenosis is essential even if a surgical thrombectomy is performed.

Our primary patency at 12 months was 71% and 74% in group A & B, respectively, showing that the minority of accesses required reintervention. Our results concordant with Nikam study 2015, which used a technique very similar to ours[9].

Regarding secondary patency, our results at 12 months were 87.7% & 92.5% in both groups, respectively. The literature shows secondary patency rates of 44 to 89% at 12 months[9,10]. Also our results consistent with the results of meta-analysis published in 2009 where their 1-year secondary patency for endovascular salvage ranged from 50 to 89%[12]. This study, as performed by us, compared the results of surgical and endovascular techniques and concluded that the two modalities are comparable in the treatment of graft thrombosis.

Rescuing accesses for hemodialysis is very important and this importance was very well explained by Coentrao 2010, who compared a historical cohort in which patients with vascular access thrombosis were submitted to catheter implantation and new AVF creation to a group of patients undergoing percutaneous thrombectomy followed by angioplasty. After 6 months of follow-up, in the thrombectomy group 91% of the patients were receiving hemodialysis through an AVF, compared to only 33% of the historic cohort of catheters, although most (22 of 24 patients) underwent a new AVF. This difference may also be due to the effect of saving accesses and to other factors involved after the implementation of a better care with the vascular accesses in relation to the historical cohort[7]. We observed a similar finding in our study after the introduction of elective angioplasty of accesses with dysfunction, which reduced the need for new fistulae. Furthermore, Coentrao 2010, compared the costs of the thrombectomy versus the catheter approach, concluding that the costs where significantly higher for the second group (mean in USD 375 versus 706, p= 0.048), with the largest expenses due to hospitalizations[7].

Concordant with our results, the literature shows a complication rate of up to 8.4% depending on the technique used[9,11,13]. In our study, complications rate was higher in group A (8.3%, 5/60) than group B (3.33%, 1/30). The endovascular technique could be preferred as the incidence of complication mainly hematoma was less and no incision was needed. The rate of restenosis and re-intervention of the grafts and venous conduits is the same in both stented and non-stent groups of our patients. So, primary stenting of underlying venous stenosis is not recommended except in failure achievement of good venous outflow after angioplasty or at recurrent stenosis after the primary intervention.

We can add to the strength of our study that all AVF thrombosis were confirmed by ultrasonography excluding cases with only severe stenosis and low flow, which may possibly have a better outcome and better prognosis. On the other hand, the negative point in our study is that, this is a retrospective study, with a small number of patients.

Conclusion

The vascular access salvage procedures can be performed after specific training, reaching complication rates and long-term access patency consistent with the existing literature. Successful endovascular salvage of the failing or thrombosed AV fistula reduces the need for central catheters, and possibly associated costs. There is no superiority of surgical technique over the endovascular one in terms of the primary technical success and for the mid-term patency rate. Also, primary stenting of underlying venous stenosis is not recommended except in failure achievement of good venous outflow after angioplasty or at recurrent stenosis after the primary intervention.

Conflict of Interest

All authors have no conflict of interest

Ethical Approval

No ethical problems raised since this is just the description of a clinical cases and no experiments or trials were done related to this study.

Authors Contributions:

Study conception: Ahmed El-Marakbi
Data collection and analysis: Ahmed El-Marakbi, Ayman Ibrahiem
Procedures and Investigation: Ahmed El-Marakbi, Abd El-Maksoud A El-Ganady
Writing: Abd EL-Maksoud A Elc-Ganady
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

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