New hybrid procedures in treating occluded arteriovenous hemodialysis grafts

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Backround. The use of arteriovenous graft is indicated in patients if the subcutaneous venous bed is exhausted or unsuitable for arteriovenous fistula creation. The leading cause of failure of a prosthetic arteriovenous hemodialysis-access graft is venous anastomotic stenosis causing thrombosis of the graft. A number of surgical techniques and endovascular tools have been used to treat this stenosis and thrombosis. None have yet proven to be ideal. This study was designed to evaluate the results of hybrid treatment of arteriovenous graft thrombosis associated with venous anastomotic stenosis.

Methods. Over the period 2013–2014, we treated 16 AVG occlusions. Immediately after the diagnosis of occlusion was made, the patients underwent thrombectomy using a Fogarty catheter. After thrombectomy, a diagnostic fistulogram was performed and if VAG stenosis was confirmed, it was treated with balloon angioplasty and stent graft introduction. Lesions were dilated to reduce the stenosis in the treated area to less than 25%.

Results. Primary patency after 12 months was 32.8%. Primary assisted patency was 44.7%, secondary patency was 47.6%. Restenosis of the stent graft was seen in two patients. Recurring AVG occlusion was observed in four patients. The average number of interventions to maintain AVG patency was 1.18 per patient/1 year of dialysis.

Conclusion. Treatment of AVG thrombosis due to VAG stenosis by hybrid procedure proved to be effective and improved secondary patency.

Key words: arteriovenous graft for hemodialysis (AVG), venous anastomotic stenosis (VAG), AVG thrombosis, surgical thrombectomy, stent graft

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INTRODUCTION

Hemodialysis vascular access dysfunction is a major cause of morbidity and mortality in hemodialysis patients. Prosthetic arteriovenous grafts (AVG) are indicated in patients with failed arteriovenous fistula or inappropriate vessels. Grafts composed of expanded polytetrafluoroethylene (ePTFE) are widely accepted. Advantages of ePTFE grafts include short maturation time and multiple potential access sites. AVGs are associated with a greater morbidity than autogenous fistula. Their great disadvantage is their propensity for venous outflow stenosis (VAG stenosis = venous anastomosis of the graft) caused by endothelial and fibromuscular hyperplasia. Stenosis at VAG, leading to thrombosis, is the primary cause of vascular access failure. Graft thrombosis is the most frequently encountered complication in AVG. AVG functionality is limited[1,2]. Graft thrombosis can be treated surgically, endovascularly or by hybrid procedure[3]. This study evaluates the results of a hybrid treatment (minimally invasive surgery plus endovascular treatment; stent graft) of arteriovenous graft thrombosis associated with venous anastomotic stenosis.

MATERIALS AND METHODS

Over the period 2013 - 2014, we treated 16 AVG occlusions. All reviewed grafts were 6 mm ePTFE (Rapidax®, Vascutek Ltd., Renfrewshire, UK) grafts localized on the upper arm (brachiobrachial). The average duration of functionality to occlusion was 9 months. Immediately after the diagnosis of occlusion, a thrombectomy using a Fogarty catheter (open graftectomy near the arterial anastomosis) was performed at a hybrid theatre and under peripheral nerve block. Arterial inflow was controlled. Regional heparin was administered. Angiography of AVG, VAG and of the outflow tract was performed (Fig. 1). The average length of VAG stenosis was 3.9 cm (±1.2 cm). VAG stenosis was treated with balloon angioplasty and a 70 x 50 or 100 mm stent graft was introduced (Viabahn®, Gore, Flagstaff, USA) (Fig. 2). Stent graft diameter corresponded with the lumen of the prosthesis and its length corresponded with the length of the stenosis so that a possible skip lesion on the efferent vein was covered. Lesions were dilated to reduce the stenosis in the treated area to less than 25%. Antiplatelet agents and intravenous prophylactic antibiotics were administered. Graft function was evaluated clinically and by ultrasound. Magnetic resonance angiography was performed 8 and 20 weeks after the index procedure, unless a problem with AVG function was clinically demonstrated. The follow-up period of patients with AVG with stent graft was one year.

RESULTS

Primary patency after 12 months was 32.8%. Primary assisted patency was 44.7%, secondary patency was 47.6%.

During the follow-up period, 9 occlusions were observed, two were in the early postoperative period- within 30 days of the VAG intervention (1st postoperative day and 3rd week). All occlusions were treated by the same technique- surgical thrombectomy with follow-up angiography:

In 1 case stent graft stenosis was confirmed and dilation was performed.

In 6 cases the occlusion was caused by stenosis in the prosthesis and/or in the outflow tract, these were treated by dilation.

In 2 cases the cause of occlusion was not explained on the angiography, which showed only physiological findings, these were treated only by thrombectomy.

During protocol MR angiography and ultrasound examination, in-stent restenosis was discovered in two patients. After undergoing PTA, these patients completed the follow-up period without subsequent AVG occlusion.

Repeat AVG occlusion occurred in 4 patients; in two of these patients the mechanical cause of occlusion was not determined and in the other two patients additional stenoses were discovered in the AVG prosthesis.

Three AVGs with stent graft had to be removed for clinical and laboratory signs of infection (16th week, 28th and 36th week).

The average number of interventions to maintain patency of the AVG with stent graft was 1.18 per patient/ year of dialysis. The patency results are presented in Table 1 and the results are represented by Kaplan-Meier curve in Fig. 3.

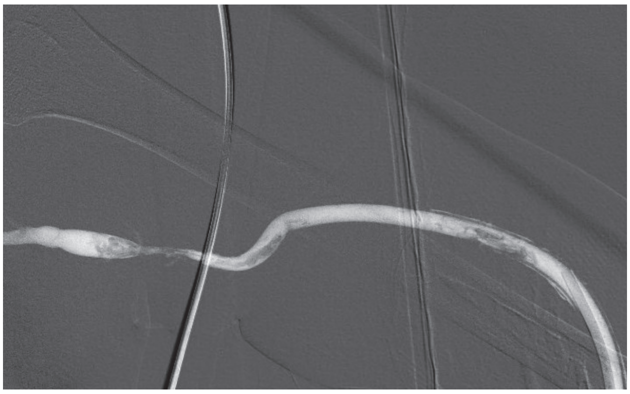

Fig. 1. Confirmed VAG stenosis after thrombectomy using Fogarty catheter.

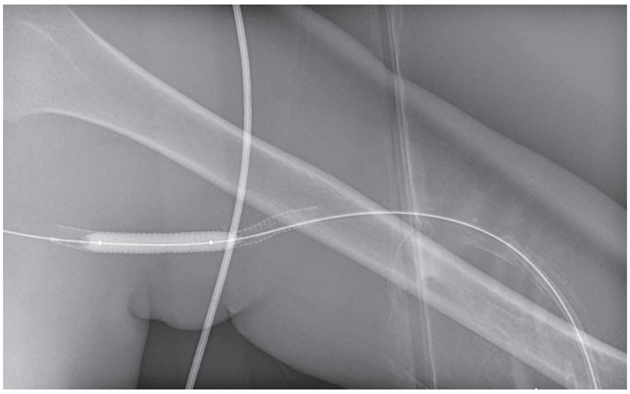

Fig. 2. Stent graft implantation into the VAG.

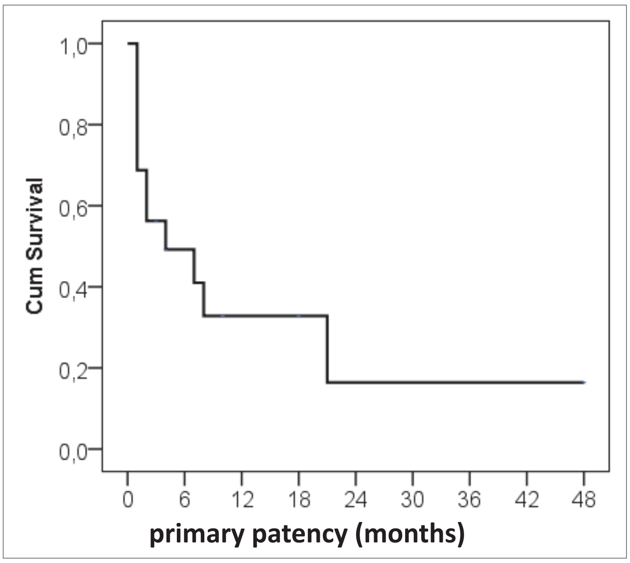

Fig. 3. Primary AVG patency in peroperative angioplasty and stent graft implantation into the VAG.

Table 1. Results of AVG thrombectomy with peroperative angioplasty and stent graft implantation into the VAG.

	8 weeks	20 weeks	12 months
primary patency	68.2%	49.2%	32.8%
primary assisted patency	68.2%	55.6%	44.7%
secondary patency	94.5%	74.5%	47.6%

DISCUSSION

Treatment of AVG thrombosis should be performed urgently to minimize the need for a temporary HD catheter[4]. Prior to the introduction of central venous catheter, all efforts should be made to renew AVG function. Each institution should determine which procedure, percutaneous thrombectomy with angioplasty or surgical thrombectomy with AVG revision, is preferable based upon expediency and physician expertise at that center[4]. Acute AVG thrombosis requires graft thrombectomy, angiographic examination of VAG and possibly treatment of VAG stenosis. Thrombectomy may be performed surgically or using the endovascular approach. However, for continuous graft function, treatment of the VAG stenosis is essential as it is the most common cause of occlusion. This may be performed surgically, by endovascular procedure or as a combination of both (hybrid procedure) (ref.[5,6]). An innovation in the treatment of VAG stenosis in a failing arteriovenous graft is the implantation of 77stent graft[5]. This method was successfully used during hybrid treatment of AVG thrombosis, where we performed graft thrombectomy and treated VAG stenosis by endovascular procedure by introduction of a stent graft. Based on the NKF guidelines- Outcomes after treatment of AVG thrombosis, a reasonable goal after percutaneous or surgical thrombectomy is a clinical success rate of 85%, which is defined as the ability to use the AVG for at least 1 HD treatment. After surgical thrombectomy, primary patency should be 50% at 6 months and 40% at 1 year[4].

These guidelines are not quite realistic. One meta-analysis and eight randomized studies on the treatment of arteriovenous graft thrombosis were identified. Studies conducted before 2002 demonstrated a significantly better primary success rate and primary and secondary patencies of surgical thrombectomy vs endovascular intervention. After 2002, similar results for both techniques have been reported[7,8]. Results of the individual methods in the years 1995-2009 were evaluated by Tordoir who concluded that the outcome of endovascular and surgical intervention for thrombosed vascular access is comparable, in particular for thrombosed prosthetic grafts[5]. It is necessary to keep in mind that the technical success of the procedure is evaluated, but the subsequent primary function is evaluated within 3 to 6 months.

Information is lacking regarding the use of stent graft to treat VAG stenosis after AVG thrombectomy. The first larger set of patients with AVG thrombosis where a stent graft was introduced was published by Webb in 2010. He reported that after 6 months, primary patency of the intervention area was only 29%. Indications for stent graft were recoil after performed PTA after repeated angiointerventions, or in case of rupture after angioplasty[9]. Stent graft implantation was performed as a last effort to save this dialysis access route. Due to the indications and stent graft implantation tactic, his work cannot be compared to our study. The author himself is not satisfied with the results of stent graft implantation and recommends it only in cases of rupture following angioplasty or in patients where it is difficult to perform surgical revision and VAG angioplasty.

The treatment of thrombotically occluded AVGs by hybrid procedure was published by Calcina. AVG thrombosis associated to VAG stenosis was treated by open thrombectomy, covered self-expanding stent and high pressure angioplasty. Primary patency at 3, 6, and 12 months was 51.9%, 44.4%, and 16.2% respectively (mean follow-up: 15 months). Secondary patency after a new thrombotic episode and similar procedure (62.9% of cases) was 70.4%, 51.9%, and 37% respectively[10]. These results do not confirm the superiority of this method and when compared to our results, it seems that stent graft implantation into the thrombectomized stenotic VAG is more suitable.

Our results do not confirm that the use of stent graft to treat VAG after surgical thrombectomy of an occluded AVG and intraoperative VAG balloon angioplasty provides significant improvement in primary patency at one year.

Initial hybrid treatment success rate in our patients was 100%. Primary function at one year is very good compared to Tordoir's data, although it does not reach the NKF guidelines -outcomes[4,5]. It is however apparent, that subsequent treatment of VAG restenosis or occlusion (again by hybrid procedure) in patients with implanted stent graft is technically more successful and ensures better long term function than simple angioplasty or the use of a covered self-expanding stent and high pressure angioplasty. In the literature, the frequency of restenoses in implanted stent grafts in AVG is mentioned only in passing. In our set of patients, restenosis was seen in three cases, in one of these cases the restenosis led to AVG occlusion. Stent graft implantation should theoretically limit the manifestation of myointimal hyperplasia in the AVG outflow tract. Restricting the occurrence of stenosis due to myointimal hyperplasia should be ensured by a change in blood flow in the VAG area, where the original end-to-side anastomosis and stent graft introduction transforms into end-to-end. This type of anastomosis is associated with fewer manifestations and consequences of turbulence in the VAG (ref.[11]). In addition, VAG restenosis should also be restricted by the inner-covered ePTFE stent-graft by limiting the overgrowth of myointimal hyperplasia tissue. Agressive neointimal hypeplasia in AVG is probably not significantly affected by stent graft implantation and will require the development of novel systemic and local therapies.

Although the sample size in our study is small, it demonstrates that VAG stenosis leading to AVG thrombosis can be managed by angioplasty with stent graft introduction. The treatment is performed with minimal burden for the patient.

CONCLUSION

Implantation of a stent graft into the venous anastomotic stenosis of an occluded AVG following surgical thrombectomy by Fogarty catheter proved to be effective and improved secondary patency. The superiority of this method must be confirmed on a larger set of patients.

ABBREVIATIONS

AVG, Arteriovenous graft; ePTFE, expanded polytetrafluorethylene; VAG stenosis, Venous anastomotic of the graft stenosis; MRA, MR angiography.

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