Original Article

Management of giant venous aneurysms secondary to arteriovenous fistula in hemodialysis patients

Hasan Ekim[1], Dolunay Odabasi[2], Halil Basel[3], Cemalettin Aydin[4]

ABSTRACT

Objective: An aneurysmal fistula can continue to provide hemodialysis access for along time, but giant aneurysms should be operated on to prevent complication. The purpose of this study was to describe our experience of the surgical management of giant venous aneurysms that have developed as a complication of dialysis access.

Methodology: Twenty patients with giant venous aneurysms of the AVF underwent surgical procedures at our hospital from December 2003 to December 2010. The diagnoses were made by physical examination and Color Doppler Ultrasonography.

Results: There were 12 male and 8 female patients ranging in age from 29 to 68 years with a mean age of 44.6±12.3 years. Plication of the aneurysmal dilatations was performed in 17 patients. In two patients, aneurysmal dilatations were excised with restoration of the artery. The remaining one patient who received a successful renal transplantation was also associated with brachial artery aneurysm. Venous aneurysmal dilatations were excised and arterial aneurysms were repaired. All patients experienced a marked decrease in the size of venous dilatations. There were no vascular complications during the follow-up period.

Conclusion: We suggest that plication is safe and effective in controlling venous dilatation and achieving patency. Reinforcing the suture line using an external mesh may not be required. However, prospective randomized studies will be required to assess the long-term outcomes.

KEY WORDS: Giant Venous Aneurysm, Vascular Access, Renal failure, Hemodialysis, Plication.

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INTRODUCTION

The creation of an arteriovenous fistula (AVF) provides readily available vascular access for hemodialysis in chronic renal failure patients. These fistulas are prone to developing their own complications.[1] True venous aneurysms secondary to AVFs can be caused by access stenosis, either by pre-stenotic dilatation due to increased pressure, or by post-stenotic dilatation due to increased turbulence. These aneurysms can also be caused by excessive high flow.[2] However, the pathophysiology of venous aneurysm in AVF is still unclear.[3]

When an AVF causes tortuous aneurysmal dilatations, cannulation for hemodialysis can become difficult and flows can be compromised due to thrombus formation in the aneurysmal dilatation. Additionally, aneurysmal degenerations cause breakdown of the overlying skin with the associated risks of bleeding and infection.[4] In these circumstances, surgical intervention should be considered.

1. Hasan Ekim, MD,
2. Dolunay Odabasi, MD,
3. Halil Basel, MD,
4. Cemalettin Aydin, MD,
Department of Cardiovascular Surgery,
Vakif Gureba University, Istanbul, Turkey.
1-3: Department of Cardiovascular Surgery,
Yuzuncu Yil University, Van, Turkey.

Correspondence:

Dr. Hasan Ekim,
Yuzuncu Yil University,
Tip Fakultesi Hastanesi,
Maras Caddesi 65200 Van,
Turkey.
E-mail: drhasanekim@yahoo.com

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Over the past seven years, we have treated 20 patients with giant venous aneurysms of AVF. We present our experience of the surgical management of venous aneurysms that had developed as a complication of dialysis accesses.

METHODOLOGY

Twenty patients with giant venous aneurysms of the AVF underwent surgical procedures at our hospital from the beginning of the December 2003 to the beginning of the December 2010.

The initial diagnoses were mainly made by physical examination. Color Doppler ultrasonographic examinations were performed to determine aneurysm diameter and length. Ultrasonographical examinations of the vessels in the ipsilateral and contralateral forearm and upper arm were also performed to evaluate the feasibility of creating a new AVF, if required.

The size of the venous aneurysms was not the sole indication for surgical intervention. The appearance of the overlying skin (thin and tight), difficult cannulation for hemodialysis, localized pain, and the rate of enlargement of aneurysmal dilatations were also considered for surgery.

Thirteen of the procedures were performed under general anesthesia and 7 were performed under brachial block anesthesia. Due to length of the procedure and the extensive dissection, we have not preferred local anesthesia for patient comfort. Preoperative and postoperative managements were undertaken with support from the nephrology department.

All patients received intravenous prophylactic antibiotic two hours before each procedure independent of the type of correction performed. A continuous longitudinal skin incision was made along the length of the aneurysmal dilatations and extended several centimeters beyond the proximal and distal ends. The aneurysmatic dilatations were circumferentially dissected out from the anastomosis to a point where AVF became normal size. Heparin (5000 units) was given intravenously. The inflow and outflow of the AVF were controlled using vascular clamps. Then, complete excision or plication of the aneurysmal dilatations was done. In closure of the wound, redundant skin over the AVF was excised. Any areas of skin breakdown or thinning of the skin were also excised, the subcutaneous layer was closed with running 4-0 absorbable monofilament sutures and skin edges were closed with a running subcuticular suture of 3-0 monofilament.

We have followed all patients until their wounds were healed. Color duplex ultrasonography was performed before discharge, after three weeks.

RESULTS

There were 12 male and 8 female patients ranging in age from 29 to 68 years with a mean age of 44.6±12.3 years. Patients were referred to our department by the nephrologists at our research hospital or by surgeons from peripheral hospitals. All patients had a growing pulsatile mass at the site of their AVF aneurysms in the upper extremity with associated pain. A murmur was heard and thrill was also palpated over them. All patients were assessed clinically for adequate distal circulation, one of whom had hand ischemia due to steal syndrome. Eighteen of the AVFs were in the upper arm; two were basilic vein transpositions and sixteen were brachiocephalic AVF. There were only two Brescia-Cimino wrist AVFs.

At the time of operation, the fistulas had been functioning from 18 to 120 months, mean 28.3±21.3 months. During surgery, all aneurysms were considered true aneurysms based on the presence of venous side branches. Their diameters ranged in size from 44 mm to 88 mm (mean, 55.2±17.3 mm). Plication of the aneurysmal dilatations was performed in 17 patients. Aneurysms were completely mobilized by sharp dissection (Fig-1) and were plicated along their entire length (Fig-2), while leaving the fistula functioning. The suture lines were created on the lateral aspect of the aneurysmal dilatations in order to avoid repeated puncture of the suture lines when the fistula is used for hemodialysis. In two patients with partially thrombosed aneurysms, aneurysmal dilatations were excised and PTFE graft interposition (less than 6cm) was performed to reconstruct of the venous limb of the AVF. The remaining one patient with thrombosed aneurysms was also associated with brachial artery aneurysm. She had received a renal transplant two years before. A skin incision was made and anastomosis between artery and vein was mobilized. The proximal and distal segments of the brachial artery were identified and clamped. The brachial artery aneurysm was resected and primarily repaired by end-to-end anastomosis. Venous aneurysmal dilatations and their communicating veins were also excised. Recreation of AVF was not performed due to good graft function without any evidence of rejection.

Hematoma occurred after surgery in two patients, one of whom required surgical evacuation. All

Fig-1: Intraoperative view of circumferentially dissected multiple giant venous aneurysms.

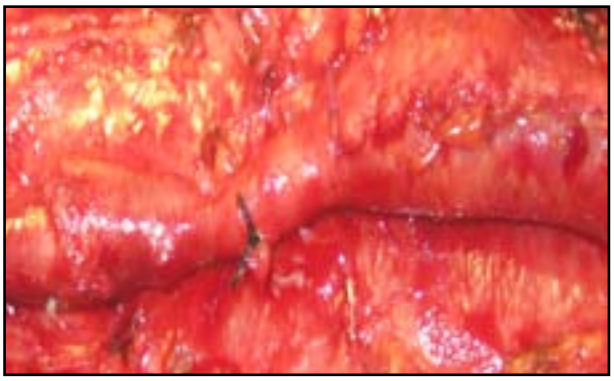

Fig-2: View of venous limb following plication of the aneurysmal dilatations.

patients experienced marked decrease in the size of venous dilatations. Follow-up periods ranged from 2 to 38 months with a mean of 26 months. There were no vascular complications during the follow-up period; all patients except one (renal transplant patient) were able to continue their hemodialysis programme, and the aneurysm did not recur in any patients.

DISCUSSION

An aneurysm is a focal dilatation of a blood vessel. The term is usually applied to dilatations of arteries. However, these lesions may also occur in venous system.[5] Etiologically, venous aneurysms are divided into congenital or acquired types.[6] The definitive cause of venous aneurysms remains unknown, although several theories have been proposed. Endophlebohypertrophy and endophlebosclerosis are important factors in a manner similar to the role of atherosclerosis in arterial aneurysm formation.[7] Congenital weakness and degenerative changes in the vein wall resulting from a connective tissue disorder or a local inflammatory process may also cause aneurysms. A significant diminution in the number and size of muscle and a leakage of elastic fibers in the walls of these aneurysms is a common finding. Fragmentation of the internal elastic lamella and replacement by fibrous connective tissue has been noted as well. Inflammation has also been cited as a possible cause of venous aneurysms.[5]

A focal vessel dilatation arising from an AVF could be either a true aneurysm or a pseudoaneurysm. A true aneurysm is a vascular dilatation containing all its wall layers intact. Conversely, a pseudoaneurysm is a dilatation with disruption of one or more layers of its wall. A pseudoaneurysm wall typically contains neointima and fibrous tissue and sometimes is lined with thrombus.[8]

Color Doppler ultrasonography is helpful in confirming the diagnosis and choosing the appropriate surgical approach. Other tools that may be helpful in the diagnosis of aneurysms are magnetic resonance angiography and/or fistulography with concomitant upper limb angiography.[9]

Treatment modalities include manual ligation and compression under ultrasonographic guidance, endovascular graft implantation, embolization, thrombin injection under ultrasonographic guidance and surgical reconstruction.[9] Endovascular procedures are intended to maintain patency and function of the existing access while excluding the aneurysm or pseudoaneurysm from the circulation.[8] Although stent graft preserves the access site, it essentially converts the AVF into a graft.[4] In this series, the use of stent grafts was not feasible due to giant aneurysmal dilatations.

A poorly defined complication of AVF is venous aneurysm formation.[4] Venous aneurysms occur in 5-10% of AVFs after access surgery for hemodialysis. An aneurysmal fistula can continue to provide excellent hemodialysis access for many years, but some complications are regarded as indications for surgical correction.[10] The indication for surgical intervention must be made on clinical grounds. True native vein aneurysms, as opposed to pseudoaneurysms, have a benign natural history and should be removed only when they involve the arterial anastomosis. Additionally any progressive enlargement of a true aneurysm that eventually compromises the integrity of the overlying skin, limits the potential cannulation sites, or shows signs of infection require a revision procedure.[2,11] Also, once a thrombosed venous aneurysm is diagnosed, it seems important to exclude it from the circulation.[12]

Traditionally, the treatment of focal venous aneurysms has involved resection of the aneurysmal dilatation with interposition bypass grafting using

synthetic graft.[4] This procedure conserves future access sites, but at the same time, converts an autogenous fistula into graft, as was done in our two patients. For localized aneurysms, resection with reestablishment of venous continuity with end-to-end anastomosis has also been performed.[4] However, this procedure is not applicable to the patients with giant venous aneurysms described in our series.

Karabay et al[9] described excision of the aneurysm and the communicating veins with restoration of the arterial patency. Moini et al[13] described a new technique. After ligation of the AVF, two ends of the aneurysm were cut and released for drainage of the aneurysm. Then the incision closed in layers. However, these two procedures leave the patient without a functional fistula. Therefore, various conservative techniques have been proposed for the correction of venous aneurysm. Lo and Tan[14] and Okten et al[15] suggested simple plication of the vessel using a running suture. Pierce et al[16] have proposed the use of a surgical stapler to reshape the venous aneurysm. Although lateral venorrhaphy with sutures or even stapler device may reduce wall tension, the wall itself remains weakened. Therefore, the metal mesh has been used to prevent further aneurysmal dilatation by Grauhan et al.[10] Nevertheless, metal mesh represents foreign matter, which increases the risk of infection.[10] Additionally, the presence of the metal mesh or stapler or of a thick plication could hinder needling.[3] Therefore, Berard et al[3] used polyester mesh to reinforce the vein after aneurysmorrhaphy to avoid these problems. Similarly, Balaz et al[17] have also described a procedure of pseudoaneurysm repair using aneurysmorrhaphy and an external patch of polyethylene terephthalate to reinforce the suture line. The fact that intimal hyperplasia development is reduced by the use of external prosthetic materials is explained by reduced tangential expansion of the graft wall, decrease in turbulent blood flow and, hence, reduced endothelial damage and mural thrombus formation. However, Woon et al[4] have not seen any aneurysmal degeneration of the suture lines as a result of not reinforcing the suture line. They suggested that the scar tissue resulting from the extensive dissection may be a factor in diminishing recurrence of the aneurysmal dilatation. In our series, there were also no recurrent venous aneurysms after reconstruction to date, which is consistent with the study of Woon et al.[4]

Short PTFE graft revisions (less than 6 cm) have resulted in satisfactory midterm primary patency without further consumption of the venous capital by harvesting segments of vein from other locations and without compromising more proximal access sites.[18] Therefore, we have used PTFE interposition graft to reconstruct of venous limb of AVF in two patients.

In patients who had a successful renal transplantation, the value of keeping a patent AVF remains controversial. Should the renal graft function deteriorate, creation of a new vascular access will be required if the original functioning AVF has been ligated. However, in a patient with well functioning renal graft, the risk of keeping an AVF appears to outweigh the benefits.[19] After kidney transplantation a patent AVF should be closed to avoid its potentially catastrophic complications.[19] Development of brachial artery aneurysm after kidney transplantation might be explained by the duration of placement, use of corticosteroids or use of immunosuppressives, which may potentially weaken the scar tissue.[20] Eugster et al[21] conclude that the fistula is the main trigger for dilatation of the artery. Additionally, they suggest that immunosuppression is of minor importance but may increase the total amount of dilatation. Woo et al[4] speculate that there may be an association between immunosuppression and this type venous aneurysm formation. Additionally, Lam et al[19] reported an enormous AVF aneurysm after renal transplantation. Therefore, surgical closure of an AVF should be considered in patients with good graft function without any evidence of rejection after a successful renal transplantation and after a time that has been agreed by the multidisciplinary team.[19]

CONCLUSION

Although, most of the venous aneurysms may remain asymptomatic for a long time,[22] surgical intervention should be performed to avoid complications such as local compressive symptoms, rupture, ischemia, venous hypertension, infection and embolism especially in giant venous aneurysms. Conservative surgical procedures effectively maintain patency of AVF and maximize its functional life span in addition to preserving other sites as future access options for hemodialysis. Additionally, the aneurysm site could be used for hemodialysis once the wound is healed.[14] We suggest that plication is safe and effective in controlling venous dilatation and achieving patency. Reinforcing the suture line using an external mesh may not be required. However, prospective randomized studies will be required to assess the long-term outcomes.

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