Case Series

Surgical Remodelling of Haemodialysis Fistula Aneurysms

Petr Bachleda,[1 CSc], Petr Utíkal,[1 PhD], Lucie Kalinová,[1] Monika Váchalová[1]

Abstract

Introduction: One complication of autogenous arteriovenous fistula (AVF) for haemodialysis is the formation of a venous aneurysm. Clinical picture: The clinical picture is typically an expanding aneurysm leading to skin atrophy and ulceration with the risk of rupture and infection. Aneurysm also reduces the potential cannulation area. Treatment: The cases described here used a surgical 'remodelling' technique involving complete skeletonisation of the venous aneurysm, reduction of lumen diameter and retention of vein wall using a Hegar dilatator to remodel a new fistula. Outcome: Six patients were treated using this method and the arterior venous shunt (AVS) was used for haemodialysis the following day. No recurrent aneurysm developed. Conclusion: Remodelling of aneurysmal AVF is an effective and low-risk option for managing this kind of complication, allowing direct access for haemodialysis.

Ann Acad Med Singapore 2011;40:136-9

Key words: Arteriovenous fistula, Vascular access, Vessel dilatation, Surgical complication, Surgical treatment

Introduction

The Kidney Disease Outcomes Quality Initiative (DOQI) guideline 3 recommends autogenous radiocephalic and brachiocephalic arteriovenous fistula (AVF) as the first and second choices of treatment for primary permanent vascular access in patients with kidney failure.[1] A native arteriovenous fistula is now widely accepted as the vascular access of choice of treatment in patients undergoing haemodialysis due to its low complication and high patency rates. However, even though superior to catheters and grafts, AVF complications, mainly stenosis and thrombosis, are the leading cause of morbidity in the haemodialysis population. Furthermore, one late possible complication is aneurysmatic dilatation of the arterialised vein bed. This not only reduces the available sites for cannulation, it can also lead to thrombosis and/or rupture with massive haemorrhage. Expansion of the venous aneurysm can lead to skin atrophy and ulceration with the risks of infection and rupture. Aneurysmatic dilatations can also seriously reduce the patient's quality of life. It is necessary however to distinguish these aneurysma from the pseudoaneurysms that can form after cannulation using synthetic grafts.

Aneurysms may occur not only as a result of repeated trauma from dialysis needling but also as a result of repeated angioplasty in the areas of recurrent stenosis.

The cause of the dilatation is believed to be degenerative changes to the wall of the vein as a result of damage due to repeated cannulation during dialysis. Another factor is the increase in pressure in the arterialised vein blood stream. The stenosis of the vein itself or its central outflow can also contribute to the increase in pressure.

Treatment of aneurysmal AVF involves either ligation or resection with prosthetic interposition. Other methods of treating AVF have been proposed to maintain autogenous access. This paper describes a remodelling technique in the management of AVF pseudoaneurysm.

Clinical Picture and Treatment

Eleven patients with large aneurysmatic dilatations of the arterialised vein autologous fistula were followed-up from 2007 to 2009. Two patients had functional graft transplants

[1] Vascular and Transplantation Surgery, University Hospital, Olomouc
Address for Correspondence: Dr Lucie Kalinová, Department of Vascular and Transplantation Surgery University Hospital Olomouc, IP Pavlova 6, 77520 Olomouc, Czech Republic.
Email: lucie.kalinova@email.cz

and no fistula. In 9 patients, the fistula for dialysis was dysfunctional. Two transplant patients indicated their desire to remove the fistula for cosmetic reasons. As for the rest, indications for revision were shortness of the potential cannulation area, aneurysm enlargement and skin atrophy. No other complications of the arteriovenous fistula were found.

Each patient was examined by color doppler ultrasonography (CDU) before the operation for assessment of flow through the fistula and quality of the flow in the vein over the aneurysmatic dilatation for detection of stenotic complications. The same was used to assess the central outflow. We found no evidence for any stenosis of the central outflow vessel.

All 11 patients with aneurysmatic dilatations of the arterialised vein autologous fistula underwent surgical procedure. The mean follow-up after the procedure was 17 months (range, 5 to 32).

In the 2 patients who insisted on removal of the fistula, this was done using ligature and under local anaesthesia. In 3 patients, the fistula was exstirpated under general anaesthesia and replaced with 6 mm of ePTFE prosthesis Rapidax (Vascutec®) to be directly used in haemodialysis. In the other 6 patients, we performed a remodelling of the fistula (Fig. 1). Under general anaesthesia, a skin incision was made over the entire affected section of vein. The operating field extended from arterial anastomosis up to the non-dilated section of the vein. The aneurysmatic vein was completely skeletonised (Fig. 2). The central venous access of the fistula was always left untouched as this section was intended for postoperative haemodialysis. After isolation, the fistula was shortened as required and the aneurysms partially resected (the diameter of the lumen was reduced). In the remaining vein wall, a new fistula of 6 to 7 mm was remodelled using a Hegar dilatator. The vein was stitched using running prolene sutures (Figs. 3 and 4). After the remodelling, the vein was locally flushed with heparinised saline solution (5000 IU/100ml saline). After restoration, the flow was measured to be 500 to 600 ml/min. In the case of high flow, the fistula was narrowed. No low flow was encountered. A redon drain was placed in position and the wound closed in 2 layers. The redon drain was removed after 48 hours. Patients were not heparinised during surgery and antibiotics were not used. In the postoperative period, antiaggregation drugs were used (acetylsalicylic acid 100 mg/day).

Fig. 1. Aneurysmatic brachiocephalic arteriovenous fistula prior to the remodelling procedure.

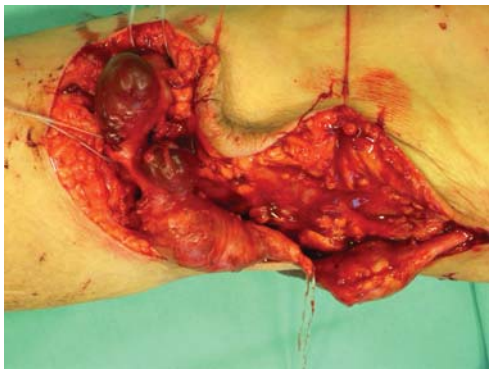

Fig. 2. Skeletonized venous aneurysm.

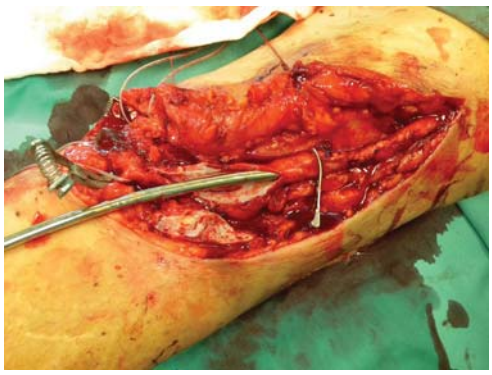

Fig. 3. Remodelling of the vein on a Hegar dilatator.

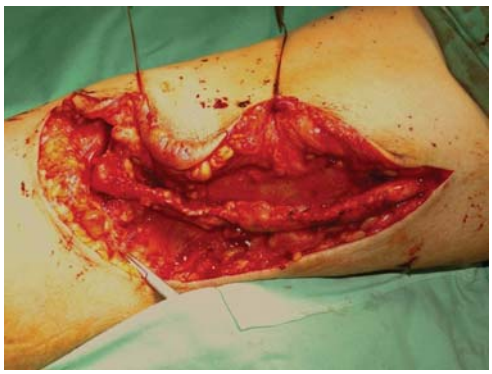

Fig. 4. Vein after remodelling.

Outcome

Patients with ligation of the fistula were released on the day of surgery. Haemodialysis was successfully performed on patients with interpositional ePTFE graft

the following day. In one patient, thrombosis due to global causes occurred 10 days after the operation but following treatment by thrombectomy, the interpositional graft was functionally restored. In the following period, we reviewed the interpositions for stenotic and thrombotic complications, and the overall secondary function were 17 and 19 months, respectively.

In patients with autologous remodelling of the fistula, we found no postoperative complications. The redon drain was removed 24 hours after surgery. Immediately after the remodelling, the non-operated proximal segment of the original fistula was used for haemodialysis. All dialysis procedures took place without complication and the wounds managed to heal properly. Remodelled sections were used for dialysis on average 20 days after surgery.

Patients still have a functional remodelled fistula which is used in the dialysis (Fig. 5). They all continue to use their AVF up to and including the time of this report from 8 to 12 months. The remodelled AVF is monitored using color doppler ultrasonography. No new local complication has been found, including aneurysmatic dilatation, stenosis or thrombosis. With color duplex ultrasound imaging at 6 months after the remodelling, we showed that the lumen had increased by 1 mm and the flow rate was in the range of 480 to 720 ml/min. In one case, there was swelling of the hand due to stenosis of the subclavian vein 5 months after remodelling. The patient was treated with percutaneous transluminal angioplasty PTA, followed by correction of local findings and restoration of the AVF function.

Conclusion

Aneurysmatic dilatation of autologous arteriovenous fistula for dialysis is an uncommon late complication of AVF. Large aneurysms threaten the function of the AVF, limit the potential access areas for needling and can result in rupture and massive bleeding. The incidence of rupture is 0.8% to 5.2%.[2,3] It is also necessary to distinguish these aneurysms from the false or pseudoaneurysms where no vessel is present in wall of the dilatation. Diagnosis is made by inspection and palpation. If treatment is required, color doppler ultrasonography should be used. This non-invasively confirms the clinical diagnosis of aneurysm and assesses the flow through the fistula. Evaluation of the central outflow using this method also allows for detection of possible stenosis. The aim of the treatment of the aneurysmatic fistula was to treat the aneurysm while maintaining fistula function. Indications for revision show signs of danger of aneurysm rupture and shortening of the potential cannulation area. Literature reviews describe conservative treatment of aneurysms such as the application of thrombin, endovascular stents and ultrasound-guided compression repair in the treatment of pseudoaneurysms in arterialised vein or afferent artery.[4,5]

Fig. 5. Functional fistula 8 months after remodelling procedure.

Surgical treatment options are limited. Traditional surgical repair of aneurysmal AVF generally involves either ligation or resection using a prosthetic interposition. Ligation of the fistula is the least desirable option even if assuming the patient has a functioning transplanted kidney. Alternatives include short ePTFE prostheses which allow early access for dialysis.[6] However, the function of the prosthesis is limited by graft thrombosis, a frequent complication of the interposition. Anatomic stenoses occur in the venous anastomoses due to intimal hyperplasia.[7] Aneurysm can be successfully treated using percutaneous insertion of endoprosthesis. Vascular access is preserved and can be used the day after the procedure.[8,9] Surgical methods also include reduction aneurysmoplasty. Firing staple lines longitudinally along the axis of the venous aneurysm and excision of aneurysmal tissue anterior to the staple lines has been described.[10] A simple and inexpensive method with good midterm results involves revision resection of redundant length, reducing the luminal diameter and reconstructing the fistula.[11] Where appropriate in anatomical terms and when it is unnecessary to shorten the fistula, plicating the free wall of the aneurysm with sutures without resection or anastomosis has been recommended.[12] Some authors with good experience recommend, apart from remodelling aneurysmorrhaphy and outer aneurysm, the use of periovascular metal mesh tubing or external PET prostheses (aneurysmorrhaphy combined with implantation of porous polyethylene external prosthesis terephthalate). These methods prevent the development of new aneurysms.[13,14]

Our method can be included as a reduction in aneurysmoplasty and is very similar to the procedure of Woo et al.[11] After remodelling, the access was restored and needling of AVF for dialysis could be continued above the remodelled section the day after the procedure. We followed the AVF (cannulated) over a relatively long period of its

duration and found no significant dilatation of the operated segment. From our experience, external support of the remodelled section is unnecessary. The method described above is simple, does not use foreign materials and preserves the function of the autologous haemodialysis fistula.

REFERENCES

1. NKF-K/DOQI Clinical Practice Guidelines for Vascular Access, update 2000. Am J Kidney Dis 2001;37:S137-81.
2. Haimov M, Baez A, Neff M, Slifkin R. Complications of arteriovenous fistulas for hemodilaysis. Arch Surg 1975;110:708-12.
3. Zibari GB, Rohr MS, Landreneau MD, Bridges RM, DeVault GA, Petty FH, et al. Complications from permanent hemodialysis vascular access. Surgery 1988;104:681-6.
4. Witz M, Werner M, Bernheim J, Shnaker A, Lehman J, Korzets Z. Ultrasound-guided compression repair of pseudoaneurysms complicating a forearm dialysis arteriovenous fistula. Nephrol Dial Transplant 2000;15:1453-4.
5. Corso R, Rampoldi A, Vercelli R, Leni D, Vanzulli A. Percutaneous repair of radial artery pseudoaneurysm in a hemodialysis patient using sonographically guided thrombin injection. Cardiovasc Intervent Radiol 2006;29:130-2.
6. Georgiadis GS, Lazarides MK, Lambidis CD, Panagoutsos SA, Kostakis AG, Bastounis EA, et al. Use of short PTFE segments (<6cm) compares favorably with pure autologous repair in failing or thrombosed native arteriovenous fistulas. J Vasc Surg 2005;41:76-81.
7. Albers FJ. Causes of hemodialysis access failure. Adv Ren Replace Ther 1994;1:107-18.
8. Allaria PM, Costantini E, Lucatello A, Gandini E, Caligara F, Giangrande A. Aneurysm of arteriovenous fistula in uremic patients: is endograft a viable therapeutic approach? J Vasc Access 2002;3:85-8.
9. Mantha ML, Baer R, Bailey GS, Wu RL, Killen JP. Endovascular repair of hemodialysis fistula aneurysm with covered stents. Kidney Int 2009;76:918.
10. Pierce GE, Thomas JH, Fenton JR. Novel repair of venous aneurysms secondary to arteriovenous dialysis fistulae. Vasc Endovascular Surg 2007;41:55-60.
11. Woo K, Cook PR, Garg J, Hye RJ, Canty TG. Midterm results of a novel technique to salvage autogenous dialysis access in aneurysmal arteriovenous fistulas. J Vasc Surg 2010;51:921-5.
12. Lo HY, Tan SG. Arteriovenous fistula aneurysm – plicate, not ligate. Ann Acad Med Singapore 2007;36:851-3.
13. Dedow E, Kaduk M. The Biocompound Shunt as a method of treatment of a.v. fistula aneurysm – a critical assessment. Zentralbl Chir 2006;131:42-4.
14. Balaz P, Rokosny S, Klein D, Adamec M. Aneurysmorrhaphy is an easy technique for arteriovenous fistula salvage. J Vasc Access 2008;9:81-4.