PRACTICAL PROCEDURES

How to perform an arteriovenous fistula

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Introduction

Endogenous arteriovenous fistula (AVF), first described in 1966, remains the optimal vascular access for chronic dialysis. An internal AVF avoids the disadvantages of an external appliance, such as frequent septic and clotting problems. In spite of surgical innovations, such as autogenous vein interpositional grafts, bovine heterografts, expanded polytetrafluoroethylene (ePTFE) grafts and permanent indwelling silastic central venous catheters, the Brescia–Cimino fistula has remained the best access for maintenance haemodialysis because of its low incidence of complications and high long-term patency rate. The 1- and 3-year cumulative patency rates are 85–90% and 60–85% respectively.

General technique considerations

End-to-side anastomosis is preferred as it produces a higher fistula flow compared to the side-to-side configuration. For construction of a distal internal fistula in a child weighing less than 20 kg, the anastomosis is performed with 8/0 or 9/0 prolene sutures. Whatever technique is used, the vessels must be handled gently to minimize damage and prevent vasospasm.

The distal radial-cephalic anastomosis, just above the wrist, is still the best site for an internal AVF. This provides a relatively long and straight cephalic vein for catheter insertion. It also leaves more proximal sites for future use should the radial-cephalic fistula fail. An AVF within the anatomic snuffbox has a high incidence of early failure and requires a longer maturation time. The proximal elbow fistula predisposes to ischaemic complications and can lead to congestive heart failure as a result of increasing flow through a chronic fistula that is made too large.

Technique for radial-cephalic fistula

This procedure can be performed under local anaesthetic (without adrenaline) on a day-case basis. The patient lies in the supine position with his/her arm outstretched on an arm board. After aseptic preparation, the operative field is draped. The forearm is maintained in a neutral position. The radial artery pulsation is palpated, a tourniquet applied and the course of the cephalic vein outlined. After local infiltration with 1% lignocaine or 0.5% bupivacaine, a curved transverse incision is made along a line crossing the radial artery and the cephalic vein. The cephalic vein is mobilized first to assess its calibre and dissected free from the deep subcutaneous tissues. A vessel loop is placed around the vessel and mobilization is completed with sharp dissection and minimal manipulation to avoid vasospasm.

The wrist is then supinated to allow dissection of the radial artery. The radial artery, flanked by its two venae comitantes, is exposed when the fibrous flexor retinaculum that overlies the artery separates it easily from the venae comitantes, although an occasional branch crosses over the artery, and mobilization of the vessel is completed with ligation and division of its fine side branches. Failure to divide these small branches often results in meddlesome bleeding. The cutaneous branch of the radial nerve to the thenar area should be preserved.

Following exposure of the artery, the vein is divided distally and the proximal end is flushed with heparinized saline. The anastomosis is best performed under magnification. Loops provide a magnification of 2.5x. An arteriotomy is made by a number 11 blade and extended with a small straight scissors to a length of 1 cm. Two anchoring sutures (6/0) are used to retract the lateral walls of the artery. A polyethylene tube connected to a syringe with heparinized saline is passed proximally into each vessel to check for proximal obstruction Both the proximal and distal vessels are irrigated with heparinized saline.

The anastomosis is started with a double-armed 6/0 or 7/0 prolene suture. The needles are pasted from the inside to the outside of the vessels at a point 1 mm beyond the distal end of the arteriotomy or venotomy. A similar suture is placed at the proximal end. Both sutures are tied with the knots outside the vessels. The anastomosis should be started from the proximal end because this is functionally the more important end and a site where technical error cannot be tolerated. Continuous full-thickness sutures are placed 1 mm apart beginning 1 mm from the original knot. After the first two stitches have been completed, it is prudent to check the proximal anastomosis with a probe to make sure that the lumens have not been compromised.

Before completing the anastomosis, each vessel is irrigated through the tubing with heparinized saline. This manoeuvre helps to ensure patency of the vessel and to flush out any clots formed during the period of vascular occlusion. The vessel loops are released after tying the last stitch. A little bleeding may occur through the suture holes but this usually stops after a few minutes of gentle pressure.

The subcutaneous layer is approximated with interrupted 3/0 Vicryl sutures and the skin is closed with a running subcuticular 4/0 Vicryl. A good thrill should be felt over the fistula and over the vein above the level ofthe fistula.

Alternative sites for AVF

Alternative sites for AVF include anastomic snuffbox fistula, high radial-cephalic forearm fistula, elbow arteriovenous fistula and transposed basilic vein AVF.

Stapling in vascular access surgery

Alternative anastomotic technique

The use of vascular closure system (VCS) (staples made from titanium), a relatively new technique in vascular surgery, has previously shown encouraging results in a variety of different vascular anastomoses in animal and human models. In these preliminary studies, the technique has been correlated with less anastomotic bleeding, decreased anastomotic and operative times and reduced early thrombotic complications. Hislological studies in animals demonstrated earlier endothelialization and less intimal hyperplasia in anastomoses created with the VCS compared to sutured anastomosis. The distinct advantage of the VCS is that they do not penetrate the vessel, disrupt the endothelium or have an intraluminal component. In addition, the interrupted anastomosis allows for dilatation and growth of the vessel.

The approximation of the artery and vein is done with 6/0 prolene stay-sutures. The arterial and venous walls are approximated and everted symmetrically by using a tissue approximation forceps and the titanium clips are applied by using the disposable clip applier (VCS autosuture). Large staples (span between legs before closure 1.4 mm) are used in brachial AVFs and medium staples (span between legs before closure 1.2 mm) in radial AVFs. The time necessary to complete that anastomosis is approximately 5 minutes.

In the author's experience, the use of the VCS correlated with creating an excellent anastomosis and minimizing blood loss and operator time. There were no primary failures and the long-term results are very encouraging since all AVFs are currently used for dialysis.

Postoperative care after AVF construction

The ipsilateral upper extremity is kept elevated to minimize oedema and discomfort. The patient is taught how to recognize the thrill over the proximal vein and the importance of unimpended flow through the fistula to maintain potency. The patient is advised to wear loose sleeved garments, to avoid lying on the fistula-bearing extremity, and is forbidden to use the fistula limb for blood pressure measurements, blood drawing or intravenous infusions except in extreme emergencies.

Exercises such as squeezing a squash ball, which increase flow through the fistula to accelerate maturation of the fistula, are encouraged and should be instituted 7 days following fistula formation.

Premature cannulation of the fistula may result in vessel damage and haematoma formation, which predisposes to early fistula failures and the formation of venous stenosis at the puncture site. Therefore an internal AVF should not be used for 6 weeks after the operation. In any case, the proximal veins must not be cannulated for dialysis until they have acquired the resilient consistency of well-arterialized vein.

Conclusions

The choice of access modality varies widely, with a predominance of prosthetic grafts in the United States of America, while endogenous AVF predominate in Europe. The advantages offered by endogenous AVF underlines the need to improve construction and maturation of these fistulas. As highlighted by Besarab and Escobar (1999), the success of AVFs depends on adequate arterial in-flow, venous anatomy and venus out-flow. A good radial pulse with a normal Allen's test and a patent cephalic vein will certainly lead to the maturation of an AVF with adequate intra-access flow for dialysis. Where forearm vessels are not suitable for AVF construction, the surgeon should proceed to evaluate elbow AVFs with confidence, knowing that the results are equally good. BJHM

Conflict of interest: none.

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Further reading

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KEY POINTS

- The distal radial-cephalic anastomosis is still the best site for an internal arteriovenous fistula (AVF)
- The proximal elbow fistula predisposes to ischaemic complications and can lead to congestive heart failure as a result of increasing flow through a chronic fistula that is made too large.
- The anastomosis should be started from the proximal end because this is functionally the more important end and a site where technical error cannot be tolerated.
- The use of vascular closure system has previously shown encouraging results in a variety of different vascular anastomoses in animal and human models.
- A good radial pulse with a normal Allen's test and a patent cephalic vein will certainly lead to the maturation of an AVF with adequate intra-access flow for dialysis.