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Techniques in Vascular and Interventional Radiology

Percutaneous Large Arterial Access Closure Techniques

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Endovascular repair has replaced open surgical repair as the standard of care for treatment of abdominal and thoracic aortic aneurysms in appropriately selected patients owing to its decreased morbidity and length of stay and excellent clinical outcomes. Similarly, there is a progressive trend toward total percutaneous repair of the femoral artery using percutaneous suture-mediated closure devices over open surgical repair due to decreased complications and procedure time. This article describes the techniques of closure for large-bore vascular access most commonly used in endovascular treatment of abdominal and thoracic aortic aneurysms, but could similarly be applied to any procedure requiring large-bore arterial access, such as transcatheter aortic valve replacement.

KEYWORDS percutaneous large vessel closure, percutaneous repair, endovascular aneurysm repair

Introduction

With its low morbidity and excellent clinic outcomes, endovascular treatment of abdominal aortic aneurysms (EVAR) and thoracic aortic aneurysms (TEVAR) has replaced open surgical repair as the standard of care for properly selected patients. Previously, open femoral exposure (or "surgical cut down") was a necessity to repair the vessel following large sheath removal. Since Haas et al[1] first described the technique to close large arteriotomies with a Prostar XL device (Abbott Vascular, Redwood City, CA) in 1999, there has been a continued migration toward percutaneous suture-mediated closure devices with EVAR and TEVAR, namely percutaneous endovascular aneurysm repair. Many operators use a technique similar to the Prostar XL device to "preclose" the vessel, using two 6-Fr Perclose ProGlide devices (Abbott Vascular, Redwood City, CA).[2]

The ProGlide is a 6-Fr system with one pair of monofilament polypropylene sutured needles that has received Food and Drug Administration approval for vessel closure up to 21 Fr. The Prostar XL is a 10-Fr system with 2 pairs of braided polyester sutured needles. The Prostar XL device does not have Food and Drug Administration approval for preclosure of large vascular access beyond 10 Fr but has received the CE mark in Europe and is approved for use in up to 24-Fr vascular closure. Typically, 2 ProGlides are used for each access artery, whereas 1 or 2 Prostar XL devices are used for each access artery. Advantages of percutaneous suture-mediated closure over surgical closure include decreased complication rate and morbidity and increased patient (decreased time to ambulation and pain) and operator satisfaction (decreased procedure time).[3,4]

Patient Selection

Preprocedural cross-sectional imaging, usually as part of a preplanning computerized tomgraphy angiogram, including the common femoral arteries is necessary to determine if the patient is a suitable candidate for percutaneous suture-mediated closure. Contraindications to percutaneous large vessel closure include the following:

(1) Anterior wall or circumferential calcification of the common femoral artery.
(2) Significant arterial occlusive disease.
(3) Common femoral artery aneurysm.
(4) Severe obesity.

Obesity may be considered a contraindication, although the increased infections and seroma formation associated

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1089-2516/15/$ - see front matter © 2015 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1053/j.tvir.2015.04.010

with surgical cut down and the reported low rate of complications with percutaneous closure in this group should prompt operators to attempt percutaneous closure, when possible.[5,6] Morbid obesity, however, will preclude percutaneous closure as the devices may not be long enough to access the vessel. Prior groin surgery and large inguinal hernia are considered relative contraindications to percutaneous large vessel closure.

Additional consideration should be given to small caliber of access artery, typically the common femoral artery, for percutaneous closure. Bensley et al[7] found higher failure rates with percutaneous closure when access vessel size was smaller than 5 mm, possibly related to inadequate clearance of the footplate in the vessel when using the Proglide device.

Procedural Steps

Arterial Access

The patient's abdomen and bilateral groins are prepared and draped in the usual sterile manner. In the case of EVAR, a full abdominal surgical preperation is performed, should emergency conversion to open surgical repair become necessary.

The common femoral artery is identified with ultrasound, and lidocaine is administered into the skin and subcutaneous tissues. Next, a transverse skin incision is made with a scalpel at the intended entry site. The subcutaneous tissues are thoroughly dilated to the surface of the common femoral artery with a hemostat under ultrasound guidance, being aware that overly aggressive dilatation on the artery may tear the arterial wall.

The common femoral artery is then accessed with a 21-G micropuncture needle with direct ultrasound guidance, taking care to ensure entry into the anterior arterial wall below the inguinal ligament.

Once access is obtained, an ipsilateral oblique common femoral angiogram is performed though the micropuncture sheath to ensure appropriate access. If access is too low (in the superficial femoral artery or profunda femoral artery) or too high (above the inguinal ligament), the micropuncture sheath may be removed and repeat puncture may be attempted after achieving hemostasis with manual compression. Once appropriate access is achieved, a 6-Fr vascular sheath is placed to predilate the subcutaneous tract and vessel wall.

Preclose Technique With Two 6-Fr Perclose ProGlide Devices

The 6-Fr sheath is removed over a guidewire, and the first ProGlide device is placed over the guidewire. The guidewire is removed once wire lumen is at the skin surface. The device is advanced into the vessel without the wire at a 45° angle until there is pulsatile bleeding seen from the marker lumen. The device is then rotated 30° laterally from the midline and subsequently deployed. The guidewire is reintroduced into the wire lumen upon removal of the first Proglide device. During removal, the sutures are harvested with a rubber-tipped hemostat (rubber shods) and placed off to the side of the access site, toward the side the device was rotated (eg, placed laterally for 30° lateral rotation). A second Proglide device is advanced over the wire and is subsequently deployed in a similar fashion to the first, although now the device is turned 30° medially. The suture tails are typically secured with the rubber shods or Steri-Strips (3M, St Paul, MN) during the procedure.

Typically, a 8-Fr vascular sheath is required to achieve hemostasis. If there is persistent bleeding around the 8-Fr sheath, upsize to 9- or 10-Fr sheath before heparinization is usually adequate to achieve hemostasis. The arterial access site is then serially dilated with progressively larger dilators (over a stiff guidewire) before the endograft introducer device or sheath is placed. The EVAR, TEVAR, or transcatheter aortic valve replacement (TAVR) procedure is subsequently performed. At the completion of the procedure, the dilator is placed into the existing sheath before removal.

Unlike the Prostar XL device, the knots are pretied with the Proglide device, and they are sequentially advanced to the arteriotomy site with a knot pusher as the sheath is removed over a guidewire. We generally favor closure over a Lunderquist guidewire (Cook Medical, Bloomington, IN) as this allows for readvancement of a large sheath should percutaneous closure fail. The guidewire is removed following hemostasis, and the sutures are locked by pulling the white sutures (Figs. 1-8).

Preclose Technique With Prostar XL Device

The arterial entry site is dilated to 8-Fr, and the Prostar XL device is then placed over a guidewire into the common femoral artery. Once the wire lumen is at the skin surface, the wire is removed and the device is advanced without a

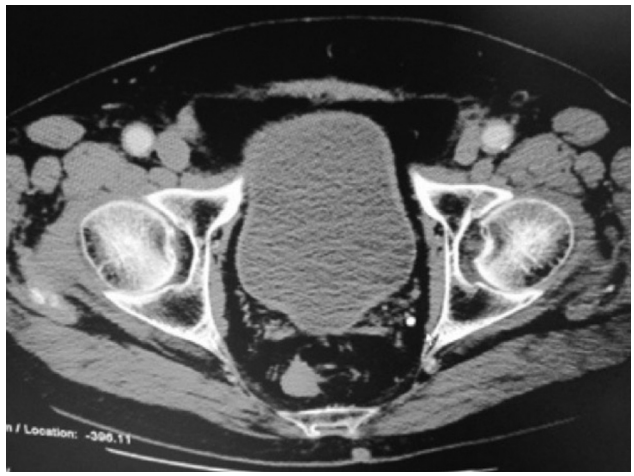

Figure 1 Steps to performing large vessel percutaneous closure with Proglide. The preprocedural CTA is examined to ensure that the common femoral artery (CFA) is suitable for large vessel closure. CTA, computerized tomgraphy angiography. Anterior wall or circumferential calcification, morbid obesity, small vessel diameter, and CFA aneurysm are relative contraindications. (Color version of figure is available online.)