Applying Micropuncture Access
When and how this technique is useful in large-sheath procedures.

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Vascular access site complications have been recognized as the most common type of complication after diagnostic and percutaneous coronary intervention performed via the femoral approach. Vascular complication rates are even higher with recent developments in the treatment of structural heart disease, namely with the placement of large arterial sheaths for device delivery, such as in transcatheter aortic valve replacement. Several procedural techniques designed to reduce these complications have been reported. Using fluoroscopy to guide vascular access leads to lower complication rates.1 However, in randomized trials, there was no significant difference in vascular complications when accessing the common femoral artery (CFA) using fluoroscopic guidance versus traditional anatomic landmark guidance.2,3 In a multicenter randomized trial, routine use of real-time ultrasound guidance for femoral arterial access found that this technique reduced the number of attempts, time to access, risk of vein punctures, and vascular complications.4

The use of closure devices has dramatically increased in recent years; they reduce time to hemostasis, facilitate patient mobilization, and decrease hospital length of stay. However, meta-analyses comparing their use to manual compression did not demonstrate a significant difference in the incidence of vascular complications.5 The Micropuncture Kit (Cook Medical, Bloomington, IN) (Figure 1), designed to allow access to the femoral artery through a very small needle (21 gauge) as compared to

Figure 1. Micropuncture access set and a standard 18-gauge needle with 0.035-inch guidewire. Reprinted with permission from Ben-Dor I, et al. Catheter Cardiovasc Interv. 2012;79:1180–1185.6

the standard 18-gauge needle, has been adopted by several operators in our laboratory and is especially important for accurate placement of large-caliber arterial sheaths.

THE MICROPUNCTURE TECHNIQUE

Puncture of the CFA is ideally performed at the level of the mid-CFA above the femoral bifurcation and at least 1 to 2 cm below the inguinal ligament. If the puncture is too
proximal, the risk of retroperitoneal hemorrhage increases.\textsuperscript{7} If the puncture is too distal below the CFA bifurcation, the risk for local complications such as pseudoaneurysm, arteriovenous fistula, and dissection increases.\textsuperscript{8}

Traditional landmark-guided access targeting the maximal femoral pulse or inguinal skin crease or line between the anterior superior iliac crest and symphysis pubis can be misleading, especially in obese patients.

Our technique for femoral artery access is performed with CFA puncture under fluoroscopic guidance from the anteroposterior view, using the mid-third of the femoral head as the puncture site (Figure 2A). Once the needle is in the artery and there is blood return, the 0.018-inch guidewire is placed through the needle under fluoroscopic guidance (Figure 2B). Because the luminal diameter of the micropuncture needle is much smaller than the 18-gauge needle (Table 1), the blood return is less brisk, and it is sometimes hard to see the pulsation, especially in hypotensive patients due to uncertainty of whether the needle is in an artery or vein (Figure 3). One option to differentiate is by the bright blood color of the artery or to connect a transducer to the needle and record the pressure wave. The needle is removed, and a 4-F sheath/introducer is then placed over the 0.018-inch guidewire into the artery. The guidewire and the introducer are then removed, and angiography in the oblique ipsilateral projection is performed via the 4-F sheath, confirming the puncture site (Figure 2C). A procedural 0.035-inch guidewire is placed through the sheath, and the sheath is then removed.

Some operators perform limited femoral angiography via the micropuncture needle using a 3-mL syringe. We prefer to perform angiography through the 4-F sheath, which reduces the risk of losing intraluminal position or vessel dissection with needle movement during the injection. In cases in which the entry site is too high or too low, the 4-F sheath is removed, and manual pressure is applied for 5 minutes. After achieving a second access site, the exact location at the level of the CFA is confirmed (Figure 4). The 4-F sheath is exchanged for a 0.035-inch guidewire to support the passage of an appropriately sized sheath.
This technique is particularly helpful for larger sheaths or when there is high bifurcation (Figure 4). In some cases, we combine the micropuncture technique with ultrasound guidance. Ultrasound helps to identify the location of the CFA bifurcation, as well as disease in the arterial wall (atherosclerotic plaque with or without calcification). This is very important when using large sheaths or in patients with severe peripheral vascular disease to avoid entry into diseased areas, especially in calcification spots in the vessel wall. With ultrasound, a micropuncture needle with an echogenic tip can be used (Figure 5), which is more visible (Figure 6).

When achieving access for transcatheter aortic valve replacement, we usually access the contralateral side with the micropuncture technique, as previously described. After crossing to the contralateral side, an 0.018-inch, Hi-Torque Steelcore wire (Abbott Vascular, Santa Clara, CA) is advanced from the contralateral femoral artery down to the superficial femoral artery. An injection with road map imaging (mask) for exact puncture site with superimposed iliofemoral anatomy is performed to ensure optimal vascular access. The micropuncture needle is advanced based on road map imaging (mask) to the CFA, and an 0.018-inch guidewire is advanced under fluoroscopic guidance (Figure 7). The needle is removed, and a 4-F sheath/introducer is then placed into the artery. The guidewire and the introducer are then removed. A 0.035-inch procedural guidewire is placed through the sheath, and the sheath is removed. A subcutaneous tissue tract is prepared down onto the artery.

Figure 5. A standard Micropuncture needle and Micropuncture needle with echogenic tip.

Figure 6. Ultrasound-guided micropuncture access.

Figure 7. Transcatheter aortic valve implantation using contralateral access; an injection was advanced from the contralateral side through the Beacon Tip Royal Flush Plus High-Flow catheter (Cook Medical) (A). Injection through the Beacon Tip Royal Flush Plus High-Flow catheter from the contralateral side with road map imaging (mask) for exact site puncture with superimposed iliofemoral anatomy (B). Micropuncture needle on road map imaging (mask) (C). Micropuncture 0.018-inch guidewire advancement (D). Fluoroscopy confirmed Micropuncture guidewire exit point from the needle (white arrow) and Hi-Torque Steelcore wire from the contralateral femoral artery down to the superficial femoral artery (black arrow) (E).
using blunt dissection with a hemostat, and two ProGlide devices (Abbott Vascular) are deployed for the preclosure technique. Then the large-bore introducer sheath is inserted after step-wise predilatation of the vessel up to the appropriate size using dilators of increasing diameter.

**CLINICAL DATA FOR ARTERIAL ACCESS**

Our center\(^6\) compared access site complications with the Micropuncture 21-gauge needle set (n = 544) to the standard 18-gauge needle (n = 2,699) in patients undergoing percutaneous coronary intervention (PCI) using the femoral approach. The micropuncture needle entry technique offers no identifiable superiority over standard arterial entry. Overall, there was no significant difference in the access site complication rate using the micropuncture technique versus standard needle (7 [1.3%] vs 27 [1%]; \(P = .54\)), respectively (Figure 8).

The overall frequency of retroperitoneal bleeding was well under 1%; however, it is important to note that its incidence was significantly higher in the micropuncture technique group (4 [0.7%] vs 5 [0.18%]; \(P = .04\)). If the risk for increased retroperitoneal hemorrhage truly exists, it may be that the angled tip of the Micropuncture guidewire poses a greater risk of arterial perforation than does the standard guidewire with its J-shaped tip (Figure 9). The angled tip tends to be diverted from the main vessel to the small side branches of the femoral or iliac arteries, whereas a J-tip serves to keep the wire in the main lumen. It is better to advance the Micropuncture guidewire under fluoroscopic guidance through the needle to the femoral-iliac arteries and abdominal aorta. Without fluoroscopy, it is plausible that the Micropuncture guidewire may inadvertently advance into a side branch, leading to perforation, and inserting the dilator/sheath while the wire is in the branch and not in the main lumen could possibly result in a dire event with a larger perforation. With the J-tip of the standard 0.035-inch guidewire, the chances of entering a branch of the iliofemoral artery are reduced.

Because the study was retrospective in nature, it is important to note that the micropuncture technique group represented a more intricate population in terms of age and others risk factors, such as lower body surface area, more peripheral vascular disease, and more renal insufficiency, which may have led to more vascular complications and bleeding as compared to the standard access group. After adjustment for baseline differences in risk factors for vascular complications between the two groups, the use of the micropuncture technique did not have an independent effect on the incidence of vascular complications.

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**Figure 8.** Rates of vascular complications in a Micropuncture access set versus a standard 18-gauge needle. Reprinted with permission from Ben-Dor I, et al. Catheter Cardiovasc Interv. 2012;79:1180–1185.\(^6\)

**Figure 9.** A Micropuncture 0.018-inch guidewire (angle tip) directed into the circumflex branch of the femoral artery (A). A Micropuncture 0.018-inch guidewire (angle tip) in the main lumen of the femoral artery (B). The 0.035-inch (J-tip) guidewire in the main lumen of the femoral artery (C). Reprinted with permission from Ben-Dor I, et al. Catheter Cardiovasc Interv. 2012;79:1180–1185.\(^6\)
The Femoral Micropuncture or Routine Introducer Study (FEMORIS) is an ongoing, randomized, double-blind, multicenter study comparing the rates of vascular complications using the Micropuncture needle introducer versus a standard 18-gauge needle to access the femoral artery in patients undergoing left heart catheterization with anticipated or possible PCI. The published study results, when available, will contribute to understanding if there are differences in groin complications when using the Micropuncture or standard 18-gauge needles.

The rates of vascular complications and access site bleeding with radial access catheterization are lower when compared with femoral access PCI in patients with acute coronary syndrome and ST-segment elevation myocardial infarction. A recent study compared the clinical outcomes of micropuncture femoral-to-radial artery access in patients undergoing PCI. Transfusion rates with femoral access using a Micropuncture needle were significantly higher compared with radial access (3.3% vs 0.05%; \( P = .003 \)). Vascular complications were higher (1.1% vs 0.05%; \( P = .051 \)) with femoral access using a Micropuncture needle.

The Micropuncture needle has been widely used in pediatric procedures. Our institution also uses the Micropuncture set for central venous cannulation, especially in patients who need an emergent line and are at high risk for bleeding, such as coagulopathy. The advantage over conventional needles is that the Micropuncture needle reduces the potential for bleeding. In cases in which ultrasound guidance is used, we usually choose the internal jugular vein. The echogenic needle is used to assist in difficult patients in whom the vascular structures are small or in patients with challenging anatomic conditions.

**SUMMARY**

The retrospective data did not show an advantage with micropuncture access compared to a standard 18-gauge needle for PCI, but there are circumstances in which the exact location of vascular excess is crucial, such as large sheath procedures. The micropuncture technique allows relatively safe removal of the Micropuncture sheath after entry before inserting a larger sheath and for patients with peripheral artery disease, in whom there may be smaller vessels to access. The only possible disadvantage is that the angled tip tends to be diverted from the main vessel and is better guided by fluoroscopy. Also, in some cases, there is no pulsatile flow through the small needle and uncertainty if the location is within artery or vein.

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**TABLE 1. LUMINAL DIAMETERS OF MICROPUNCTURE NEEDLES**

<table>
<thead>
<tr>
<th>Needle (gauge)</th>
<th>Nominal Outer Diameter (mm)</th>
<th>Nominal Inner Diameter (mm)</th>
<th>Nominal Wall Thickness (mm)</th>
</tr>
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