

# Ten Critical Lessons for Performing Transradial Catheterization

Technical tips and considerations that I have learned during my years of utilizing this approach.

BY KINTUR A. SANGHVI, MD, FACC, FSCAI

Beginning with the first radial artery (RA) access I performed in 2000, I realized that the transradial approach is the true minimally invasive, safer, patient-friendly approach for coronary and endovascular intervention. This belief eventually evolved into a “radial always, unless contraindicated” approach. Because of the safety associated with radial access, the European Society of Cardiology consensus statement has recommended that radial access should be the default approach for cardiac catheterization.<sup>1</sup>

I have learned a great deal over the years, both through personal experiences and the enthusiasm of national and international radialist friends. In this article, I share some of these important experiences and lessons.

## 1. PREPROCEDURE TESTING FOR DUAL CIRCULATION OF THE HAND

The widespread belief that patients with an abnormal Allen’s test (or Barbeau’s test) should be excluded for RA catheterization has never been confirmed in clinical trials. This remains an area of controversy and is a hot topic in the

United States, although many high-volume centers across the globe do not exclude patients based on an Allen’s test. Hand ischemia from transradial catheterization is mainly reported in the critical care literature from the indwelling arterial lines without any correlation with Allen’s test results.<sup>2,3</sup> Hata et al<sup>4</sup> reported no postoperative hand ischemia despite harvesting RAs for use as bypass grafts in a series of patients with abnormal collateral flow.

Hand circulation is much more robust than just two arteries (RA and ulnar). Recently, the RADAR trial<sup>5</sup>

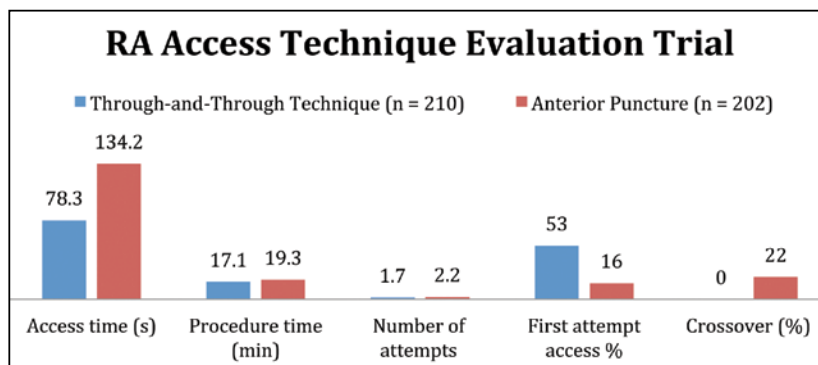
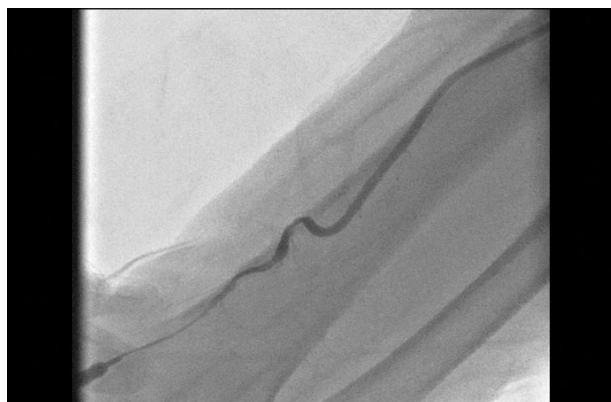


Figure 1. Randomized comparison of anterior puncture technique versus posterior puncture technique.<sup>1</sup> The first attempt is defined as the first advancement of a needle. Adapted with permission from Cholankeril M, Sanghvi K. Complications of transradial catheterization. *Cath Lab Digest*. 2013;21:32–34.



**Figure 2.** Angiography is performed by injecting through the Teflon cannula showing a tortuous distal RA.

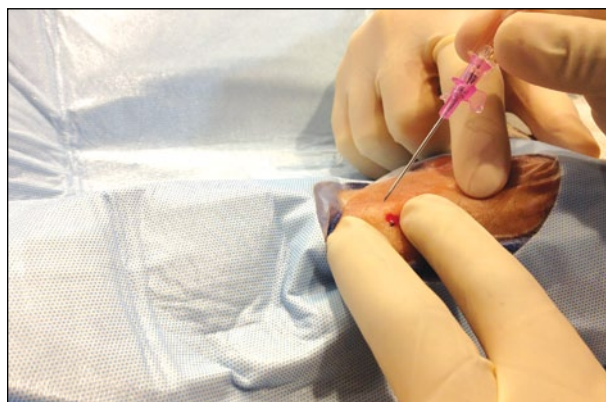
reported no signs of ischemia (based on the thumb capillary lactate level) in patients after transradial catheterization, irrespective of the Allen's test results. Some interventionists are worried about the medicolegal environment in the United States, but for that same reason, RA should be preferred over femoral access, as legal claims based on femoral access are more common than for RA.

One absolute contraindication in our lab for the RA approach is a clear history of Reynaud's phenomenon. With the mounting evidence, hopefully the guidelines will soon remove the Allen's test from preprocedural evaluation for the RA approach.

## 2. RADIAL ARTERY ACCESS TECHNIQUE

Of the two options to achieve RA access, a modified Seldinger technique (anterior wall puncture only) or traditional Seldinger technique (posterior wall puncture or through-and-through puncture), I strongly recommend the latter. It was reported in a randomized controlled trial<sup>6</sup> that the through-and-through puncture technique was a faster and probably more reliable way to achieve RA access with a shorter procedure time, shorter time to gain access, lower number of attempts, no crossovers, and no difference in complications (Figure 1).<sup>6</sup>

During the posterior wall puncture technique, a controlled pulling of the Teflon cannula, keeping it horizontally parallel to the forearm, allows for secured and easy wiring into the true lumen of the RA. If any resistance is encountered, pull back and steer an angled wire (or a 0.014-inch PTCA wire). If resistance is encountered after advancing 2 to 3 cm of the wire because of distal RA tortuosity (Figure 2), the Teflon cannula can be inserted over the wire and into the RA. Remove the wire, and if your cannula is intraluminal,

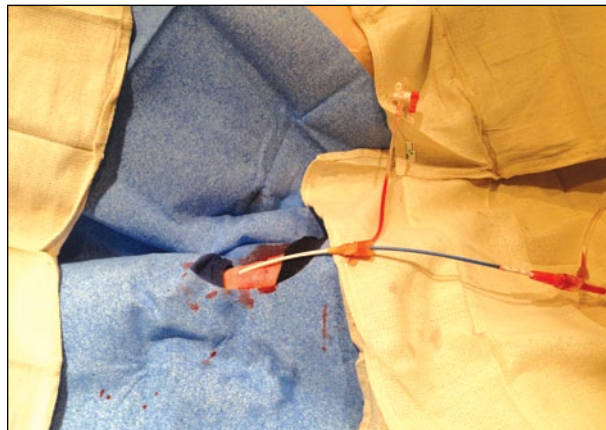


**Figure 3.** Assisted compression of the distal RA to make the RA easily palpable for successful access.

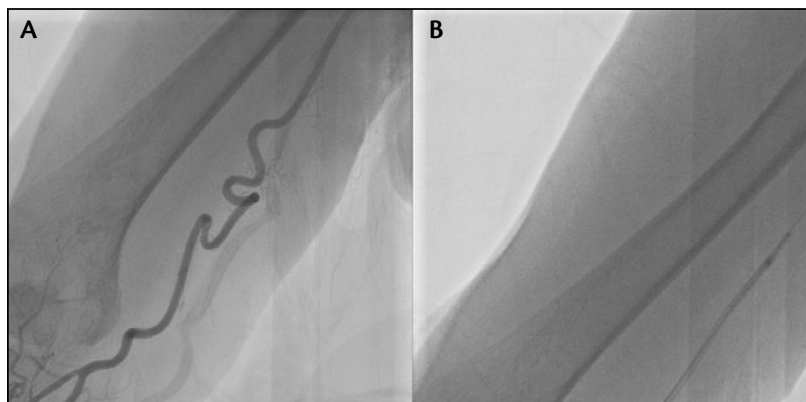
there will be pulsatile blood flow. Diluted contrast (plain contrast will burn and cause spasm) can be injected through the cannula to define the anatomy (Figure 2). With angiographic guidance, a 0.014-inch wire can be steered through the tortuous RA, and a sheath is inserted over a 0.014-inch wire.

## 3. POORLY PALPABLE RADIAL PULSE

Flow-mediated vasodilation increases the velocity of flow through the RA when it is compressed. Whenever the RA is poorly palpable, one can increase in the velocity of the flow by compressing the RA distal to the radial head close to the palmar crease (Figure 3), and the RA becomes significantly more palpable. The RA typically behaves in a way that lends itself to puncture, and this maneuver increases the odds of successful access. If the RA begins to spasm after a first failed attempt and the pulse is not palpable, the same technique can be used. Sublingual nitroglycerin (NTG) (0.4 mg) or a subcutaneous injection of 200 µg of NTG at the site of



**Figure 4.** When only 0.5 cm of the 7-F sheath is inserted in the RA, it allows the use of a 7-F guide in a smaller RA.



**Figure 5.** Very tortuous RA arising from the axillary artery (A). Balloon-assisted guide tracking (B).

lidocaine injection can further enhance the success of this technique.

#### 4. USING THE KNOWLEDGE OF RA AND SHEATH SIZES

The outer diameter (OD) of a sheath is almost 2 F larger than the OD of the guide catheter of the same French size; for example, a 6-F Glidesheath (Terumo Interventional Systems, Somerset, NJ) has an OD of 2.61 mm, and the OD of a 6-F guide catheter is 2 mm. Whenever a patient's RA appears to be small, and a long sheathless guide catheter is not available (eg, for renal artery intervention), the following technique becomes very useful. Rather than stretching the RA the entire length of the sheath, just insert 1 cm of the sheath into the radial artery (Figure 4). This provides atraumatic entry of the guide into RA, which has a smaller OD and is less likely to expand, irritate, or cause spasm or dissection in the RA. We often use a 7-F guide catheter by using this technique. Similar knowledge of the length and OD of long sheaths is equally important for transradial endovascular intervention. The currently available long sheaths that were originally designed for femoral access (60, 90, 110 cm) have nearly 1-F larger OD than a short sheath of the same French size and are more likely to cause spasm (eg, a 90-cm, 6-F sheath has an OD of 2.88 mm).

#### 5. TRAVERSING LOOPS/TORTUOSITY AND BALLOON-ASSISTED GUIDE TRACKING

Always feel for any tactile resistance while advancing the wire through the radial anatomy. When tactile resistance is encountered while advancing the wire, fluoroscopy should be used. Defining any variation in the upper limb arterial anatomy with contrast allows for successful negotiation and prevents complications. Also,

if the patient complains of severe pain while the wire is being advanced, it is necessary to perform radial angiography. The next step is to use an angled, hydrophilic, steerable 0.035-, 0.018-, or standard 0.014-inch wire. A 4-F JR 4 or similar catheter can be advanced over the wire. Once it travels through the loop, hold the wire and catheter together, pull back, and rotate clockwise, and this will straighten the loop. Once you advance a 0.035-inch wire through, it will hold the loop straight and allow a regular catheter to advance.

At times it is difficult to advance a guide catheter through loops and tortuosity, as these segments can go into severe spasm. Using additional vasodilator medication, downsizing the catheter (5 F instead of 6 F), as well as a gentle clockwise and counterclockwise rotation of the catheter while advancing it through the RA are some of the tips to successfully accomplish the intended procedure. When that fails, balloon-assisted tracking (BAT)<sup>7</sup> can be helpful. In a very tortuous RA (Figure 5), the wire is biased against the wall of the RA at multiple points as the wire straightens the artery (similar to the pseudolesions caused by a stiff wire in a coronary artery). The space between the wire and the guide lumen allows the guide catheter tip to cause trauma, irritation, and spasm in the RA at the point of the wire bias, the so-called razor effect.<sup>7</sup> BAT allows for an easy, atraumatic passage of the flexible, conical shape of the balloon at the guide tip. As the BAT assembly is advanced, the balloon tip moves the wire off the wall of the RA, thus providing dynamic wire bias and preventing trauma, irritation, and spasm.

First, carefully cross a spastic tortuous RA segment or loop with a 0.014-inch standard angioplasty wire. A guide catheter is then advanced in the RA distal to the spasm or tortuous segment. A compliant rapid exchange balloon to match the OD of the guide catheter (eg, 2 X 15 mm for a 6-F guiding catheter) is advanced over the wire to the tip of the guide catheter. The distal two-thirds of the balloon is kept outside the guide and inflated just above nominal inflation pressure. Now, the entire assembly is advanced over the wire (Figure 5). Tortuosity, stenosis, spasm, or loops can be overcome very easily using this technique. It is important that the patient is anticoagulated with at least 50 units/kg of heparin or more while performing this technique.



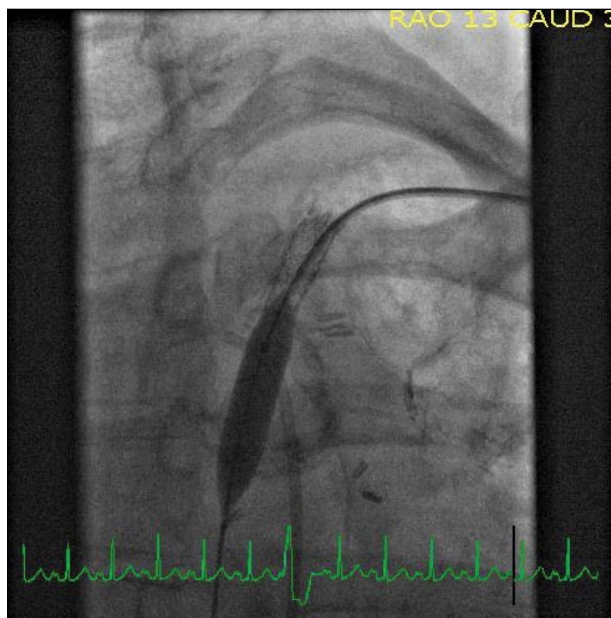


Figure 6. A 9-mm balloon is used to circumferentially flare the aorto-ostial stent struts of a 7-mm ostial subclavian stent via an ipsilateral RA approach.

## 6. IN CASE OF RADIAL PERFORATION/ DISSECTION

RA perforation, if left undetected and untreated, is rare but can lead to serious complications, including forearm hematoma or compartment syndrome. Manual compression has been suggested in the past, but it is probably not the right treatment. When a tight compression bandage is applied, the exact compression of the perforation site against the bone cannot be confirmed, which can lead to continuous bleeding in the fascial plane. The increasing fascial pressure from bleeding and the outside compression bandage can increase the risk of compartment syndrome.

Instead of stopping the procedure after detecting a perforation or dissection, cross the affected segment with a 0.014-inch percutaneous transluminal coronary angioplasty wire. Advance the catheter through the perforated/dissected RA segment, and if required, use the balloon-assisted tracking technique.<sup>7</sup> This allows the irritated RA to spasm down onto the inserted sheaths or catheter. The catheter itself works as an internal hemostatic device, and iatrogenic perforations are sealed within a few minutes while you complete the intended procedure, including intervention.

We published a case series with 100% success in sealing a perforation using the technique described.<sup>8</sup>

## 7. TRANSRADIAL SUBCLAVIAN ARTERY INTERVENTION

We always use and recommend ipsilateral RA access to perform diagnostic and therapeutic endovascular procedures for subclavian artery (SA) stenosis or occlusion. The ipsilateral RA approach allows direct access for treating SA disease and avoids the manipulation of catheters in the aortic arch. Atherosclerotic disease of the SA commonly involves ostial and proximal portions with a higher prevalence of proximal calcified stenosis or occlusion. The radial approach provides better support to cross through a chronic total occlusion (CTO) and deliver balloons or stents. Retrograde crossing of the CTO has a higher likelihood of success. From the femoral approach, selective placement of the catheter or sheath is more challenging. Contrary to what is generally thought, the CTO devices and reentry devices can be used through an RA approach as per the operator's discretion and experience. Guided by arch aortography and subclavian angiography, image overlay or the road map tool can be used to deploy a stent or balloon from the ipsilateral radial access. To flare the aorto-ostial stent, an oversized balloon can be inflated in the aorto-ostial location and pulled back; for example, a 9-mm balloon is inflated in the aorta and pulled back for circumferential flaring of the aorto-ostial subclavian stent struts (Figure 6).

## 8. TRANSRADIAL RENAL, CELIAC, OR MESENTERIC ARTERY INTERVENTIONS

A radiologic study on the origin of the renal artery reported that a mean angle made by the right and the left renal artery with the aorta is 73° and 65°, respectively.<sup>9</sup> The caudally directed openings of the renal, mesenteric, or celiac arteries require a catheter with a steep



Figure 7. The caudally directed angle of the renal (A), mesenteric, and celiac arteries (B) makes it better approached from radial access.

curve when using a femoral (caudal-cranial) approach (Figure 7). Although the renal double curve, hockey stick, or internal mammary guide shapes can provide coaxial engagement from a femoral approach, the catheter entry into the renal artery can be traumatic, particularly in difficult anatomy, due to a high prevalence of ostial atherosclerotic disease. Because of the caudally directed angle, a Judkins right or multipurpose guide catheter provides easy, atraumatic, coaxial entry into these arteries from the cranial (RA) approach. Coaxial entry and engagement reduces the risk of atheroembolism, provides sufficient support, reduces chances of guidewire-induced dissection, and allows easy device delivery. A right radial approach reduces operator radiation exposure, and a left radial approach reduces the distance to travel. Rarely, a longer (> 110 cm from the left or > 125 cm from the right) catheter may be required in patients with severe tortuosity of the thoracic and abdominal aorta when using radial access. When a problem with the guide catheter length is anticipated, the RA can be accessed 2 to 3 inches higher than normal. At this level, the RA is deeper but still separated from the major nerves in the forearm. This high entry will require extra attention to hemostasis.

## 9. TRANSRADIAL ILIAC AND COMMON FEMORAL ARTERY INTERVENTIONS

Frequently, crossover through the aortic bifurcation is hampered by severe tortuosity and calcification. Although the distance from RA puncture to the lesion site makes it seem difficult, the geometry of a straight line from the sheath parked in the aorta or iliac artery to the lesion in the iliac/external iliac artery/common femoral artery provides sufficient support for introducing a wire and other devices. If there is difficulty entering the descending thoracic aorta (DTA), a 40° left anterior oblique view, JR catheter, and an angled Glidewire (Terumo Interventional Systems) or opening the pigtail toward the DTA with a J wire will allow entry into the DTA. After performing aortography, a 125-cm, 5-F multipurpose catheter or 150-cm, 0.035-inch crossing catheter can be used to perform selective angiography by advancing the catheter up to the popliteal artery. Before initiating an intervention, note the availability of equipment in your lab that has a 135- to 150-cm shaft length and 6-F compatibility. Devices can be exchanged over a 300-cm long support wire. For most patients shorter than 5 feet 10 inches, a 110-cm sheath will reach the iliac artery from the left RA. If the sheath does not reach the iliac artery, use a 125-cm guide catheter through a long sheath to perform angiography. Use image overlay or any radiopaque landmark to deploy

the balloon or stents. In the event of iliac perforation, a 6-F sheath will not allow deployment of a covered stent. A balloon should be used to tamponade the perforation while femoral access is achieved and a covered stent is advanced from the retrograde femoral approach.

## 10. REMOVING A LONG SHEATH AFTER AN ENDOVASCULAR PROCEDURE

Radial spasm is more likely when withdrawing a long (90/110 cm) bulky sheath. Before removal of the sheath, additional conscious sedation or pain medication should be given when spasm occurs. The sheath is removed with continuous, gentle pullback. An additional dose of sublingual NTG may help if spasm occurs. When the sheath tip is pulled back into the distal RA, purge 10 mL of blood and flush the sheath with heparinized saline. An additional exit dose of intra-arterial vasodilator cocktail (200 µg of NTG and 2.5 mg of verapamil) should be given if blood pressure permits (systolic blood pressure > 100 mm Hg). A hemostatic band is applied, and the rest of the sheath can be removed.

## CONCLUSION

The evolution of arterial access techniques and technology has changed the field of endovascular medicine. RA access is often a safe alternative approach to allow diagnosis and treatment of a wide array of disease states, and the interventional community has developed multiple solutions for some of the challenges encountered during transradial catheterization. The rapid growth of transradial catheterization is based upon greater safety and patient preference, which serve to demonstrate the merits of this practice. ■

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