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How I do it: Tips, Tricks and Techniques

A PICS society education series

Radial Artery Access

Introduction:

Radial artery access can be an attractive form of alternative arterial access for cardiac catheterization, as it leads to reduced time for bed rest and a lower incidence of access site complications, such as bleeding, pseudoaneurysm, and arteriovenous fistula. In adults with acute coronary syndrome, radial access has been shown to improve mortality in patients undergoing cardiac catheterization with ST-elevation myocardial infarction, mainly driven by reduced bleeding (1). In patients with congenital heart disease, radial artery access can also be attractive as many patients have femoral arterial occlusions or stenoses from prior procedures.

Anticipated challenges of the procedure:

Challenges include confirming that the radial artery is an appropriate size, anatomical variation in radial artery anatomy that can preclude radial artery access, and radial artery vasospasm.

TIP 1. Planning and Preparation

1. Patient Positioning and Setup: Try to use dedicated radial boards to position the hand/arm. Most adult cardiac catheterization labs carry arm boards for this purpose. Adjust the table so you can perform fluoroscopy of the wrist/arm during access.

2. Imaging: Review old imaging and notes. Did the patient have a prior classic BTT shunt that precludes radial artery access on that side? Does the patient have a CT Angiogram that includes the subclavian arteries that shows significant tortuosity? Has radial access been attempted in the past with success?

3. Choice of radial artery. Traditionally the right radial artery is chosen as a convenience to the operator but consider left radial artery access in patients with history of bypass grafts, tortuous vascular anatomy, or right radial artery occlusions. Make sure the radial artery is an adequate size for cannulation (at least 2 mm in diameter).

4. Relative contraindications: Vaso-occlusive disease (Raynaud disease, scleroderma), upper extremity vascular disease (subclavian artery stenosis, AV fistula for dialysis).

Tip 2. Tools needed

1. Micropuncture needle and wire: There are two kinds of access kits, for an anterior wall stick or for the two-wall method.

2. Sheaths: The smaller the better. Terumo Slender Glidesheaths (Figure 1) are great for this purpose. A 5Fr Slender has an outer diameter of 2.14 mm, while a 6Fr Slender has an outer diameter of 2.44 mm.

3. Medicines: To prevent vasospasm of the artery. Many different cocktails exist, but I like to give a combination of heparin, nitroglycerin, and verapamil.

4. Catheters: Standard coronary catheters (Judkins left and right) are acceptable, but catheters specifically made for radial access include the Tiger and Jacky catheters. These allow for selective engagement of both coronary arteries with one catheter.

5. Imaging Devices: Ultrasound machine for access. While radial artery access can be successful without ultrasound guidance, studies have demonstrated that ultrasound guidance improves the success and efficiency of radial artery canulation (2).

6. Closure: Radial artery compression device. Use of a compression band, such as the TR Band (Terumo), allows for patent hemostasis and reduces the rate of radial artery occlusion after catheterization.

Tip 3. How I do it

1. Palpate the Radial artery. Use ultrasound to identify the artery and its course if unable to confidently palpate the artery. Although assessment of the RA pulse is important, performing an Allen or Barbeau test to confirm the patency of dual arterial circulation to the hand and intact palmar arch system is only of historical interest. Recent studies of patients with normal and abnormal preprocedural Allen test who

subsequently underwent radial access did not demonstrate differences in thumb capillary lactate, grip strength, or incidence of ischemia between the 2 groups (1).

2. Prep and Drape. Use a dedicated arm board. Sterilize a wide area and drape the area from the styloid process of the radius to about 4-5 cm proximally on the forearm. Adjust the table so the arm can be imaged if necessary.

3. Numb the area of entry with subcutaneous lidocaine. Be careful not to hit the vessel wall as this can cause spasm.

4. Puncture the skin 1-2 cm proximal to the radial styloid (3). Entering the radial artery over the bone can be painful for the patient (Figure 2).

5. If using the anterior-wall stick method, use a 4Fr micropuncture needle that is 2-3 cm in length (usually comes in the kit) at a 45-degree angle to the skin and advance the needle firmly and slowly until the front wall of the artery is punctured. I use ultrasound to guide my access. Tenting of the anterior vessel wall is usually visualized, and then the operator may feel a “pop” and see the anterior wall “bounce” as gentle pressure is applied with the needle to enter the vessel lumen. Confirm that the needle is in the middle of the lumen, visualize pulsatile blood flow from the needle, and then advance the wire. One may have to lower the angle of the needle by a few degrees to facilitate wire entry into the vessel (4). If using the two-wall method, use of a 20-gauge Angiocath needle system to puncture the anterior wall. Once a flash of arterial blood is seen in the barrel of the Angiocath, then advance the entire system until the back-wall is punctured and the bleed-back stops. Remove the needle and slowly withdraw the plastic catheter until brisk, pulsatile blood flow is obtained, confirming that the catheter is in the arterial lumen. The guidewire can then be advanced through the Angiocath.

6. Use a 0.018-0.021-inch micropuncture wire (Figure 3) with a floppy tip to access the radial artery. Do not advance the wire if there is resistance, as this could signify the wire is in a small branch or is subintimal. Fluoroscopy of the wire tracking up the artery and past the elbow may be necessary in patients with tortuous radial arteries or radial artery loops.

7. Remove the needle and then advance a sheath over the wire. A skin nick should not be necessary as radial artery sheaths are gently tapered and designed to have minimal transition between the sheath and dilator.

8. Remove the dilator, aspirate the sheath, and flush the sheath with an anti-spasmodic “cocktail” (1,4). I like to use a combination of heparin (2000-5000 units depending on

body weight, 50 units/kg), nitroglycerin (100-200 ug), and verapamil (2.5 mg). Dilute the mixture with 10-20mL of blood, as the mixture is acidic and can cause a burning sensation during infusion if injected too quickly. Flush the sheath with heparinized saline.

9. Secure the sheath with a transparent adhesive dressing.

10. At the end of the case, aspirate and flush the sheath one more time and then remove the sheath after placing a hemostasis device. I use an external compression device to maintain patent hemostasis, such as a TR band (Terumo Interventional Systems, Somerset, NJ, Figure 4). Confirm patent hemostasis by using a pulse oximetry device placed on the ipsilateral thumb or index finger and document a normal waveform.

11. Excellent video example of radial artery access by Dr. Emmanouil Brilakis (5). (https://www.youtube.com/watch?v=zQCx7wQSe-Q)

Tip 4. What complications to expect and how to deal with them

- Radial artery spasm: Make sure the patient is comfortable. Use topical lidocaine. Use of moderate sedation or general anesthesia leads to a reduction of radial artery spasm as well. Use of spasmolytic agents (nitroglycerin, verapamil) at the beginning of the case and between catheter exchanges is helpful. Anticoagulation with heparin also prevents radial artery occlusion.

- Hypotension: In patients with severe aortic stenosis, left ventricular dysfunction, or cardiogenic shock, be careful in administering spasmolytic agents, as they may reduce preload significantly.

- Radial, Brachial, Aorto-subclavian artery tortuosity. There may be significant tortuosity that makes entering the aorta difficult. Use of a 0.035-inch 1.5 mm-radius J-tip wire or 0.035-inch hydrophilic wire may help. In short patients with a short aortic root, having the patient take a deep breath “lengthens” the aorta and may make advancing the wire and catheter into the ascending aorta easier. A stiff exchange-length wire can be used to also straighten tortuous arteries when performing catheter exchanges. Use balloon-assisted tracking (a slightly inflated coronary balloon) or catheter-assisted (smaller French multipurpose or pigtail catheter) tracking if there is resistance with advancing guide catheters through the artery over the wire (1). Do not be afraid to convert to femoral access. Significant tortuosity may make catheter manipulation difficult, and extended catheter manipulation may lead to arterial vasospasm.

- Radial artery occlusion: It can occur in 3-5% of radial artery catheterizations. Use an external compression device to maintain patent hemostasis. Ipsilateral ulnar artery compression after the procedure can also reduce rates of radial artery occlusion. 50% of radial artery occlusions recanalize in 1-3 months (1).

- Radial artery avulsion: Do not remove the sheath when there is severe spasm. Use of more spasmolytics and deepening of anesthesia may be helpful.

- Radial artery hematoma: This is a rare complication, but if it occurs, adjust or reposition the external compression band to a more proximal location. It may be necessary to place a second band more proximal to the first one. If the hematoma is very large, use an inflated blood pressure cuff to provide hemostasis.

Summary:

The radial artery is an attractive location for alternative arterial access. When performed in the appropriate patient, radial artery access can lead to improved patient comfort due to reduced bed rest time as well as improved patient safety outcomes due to fewer bleeding complications. In patients with congenital heart disease, radial artery access may also be the only form of arterial access in those with a history of previous cardiac surgery or cardiac catheterizations leading to femoral artery occlusion.

References:

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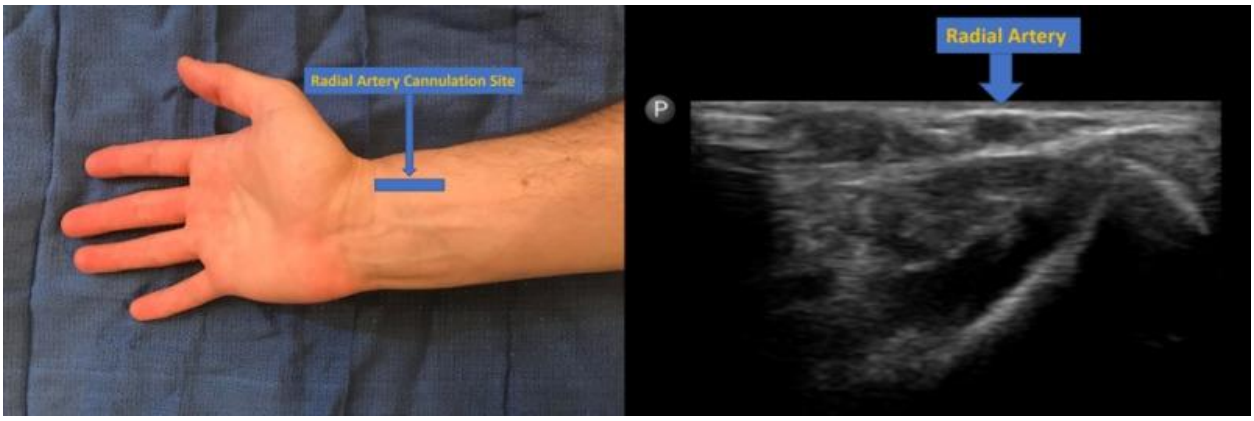
FIGURES

Figure 1: Terumo Slender Glidesheath for Radial Artery Access.

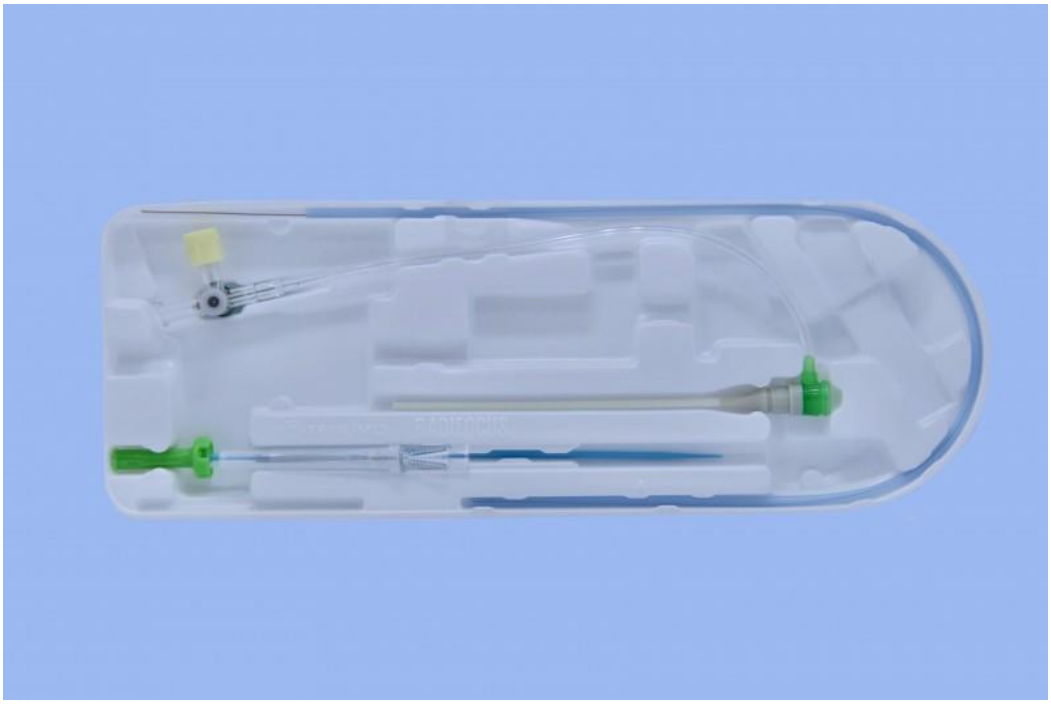
This is a 6Fr Slender Glidesheath (Terumo Interventional Systems, Somerset, NJ). It has a 2.44 mm outer diameter compared to a regular 6Fr sheath with an outer diameter of 2.63 mm. It has a thin wall that allows for a better sheath to radial artery diameter ratio, which reduces spasm and radial artery occlusion, but it does make the sheath easier to kink.

Figure 2: Radial Artery Cannulation Site and Ultrasound Image



Radial artery cannulation site and image of radial artery on ultrasound at this level. Contributed by Joshua Solano, MD (Wallace MW, Solano JJ. Radial Artery Cannulation. [Updated 2021 Jul 21]. In: StatPearls [Internet])

Figure 3: Radial Artery Access Kit



Radial artery access kit, with micropuncture needle, wire, and sheath/dilator.

Figure 4: Radial artery Compression Device

The TR Band (Terumo Interventional Systems, Somerset, NJ) is a radial artery compression device designed to assist in selective hemostasis of the radial artery after a cardiac catheterization by providing enough pressure to maintain patent hemostasis, which prevents the risk of radial artery occlusion.