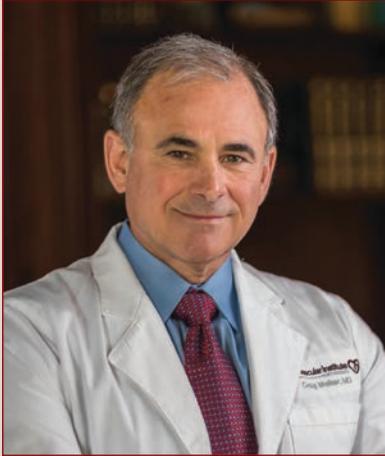


Thirteen Steps to Avoid Radial Artery Access Complications in Peripheral Arterial Interventions



Craig Walker, MD, FACC, FACP
Clinical Editor
Interventional Cardiologist
Founder, President, and
Medical Director

Cardiovascular Institute of the South;
 Clinical Professor of Medicine
 Tulane University School of Medicine
 Louisiana State University School
 of Medicine

Hello and welcome to the May 2022 edition of *Vascular Disease Management*. I have chosen to comment on avoiding potential complications with peripheral arterial interventions via radial artery access. I have decided to comment on this subject as radial artery access peripheral arterial interventions are being used far more frequently now that longer delivery sheaths, guidewires, balloons, atherectomy tools, and stents have become available. I strongly suspect that additional tools will be developed that will allow interventionists to deliver most, if not all, of the devices that have been utilized via other access sites to peripheral arteries via this access. Once there is a complete toolbox, I suspect there will be further growth in the use of radial access.

Radial artery access has certain advantages over other access sites, making it desirable to patients and interventionists. Many patients prefer radial access and request this access. This is more common in patients who have had prior coronary procedures performed by both radial and femoral artery access.

Reasons radial access preference was cited by patients include:

1. Less bleeding risk
2. Better comfort (patients can sit immediately and men can stand if necessary to urinate)
3. Earlier discharge
4. Earlier ambulation
5. Ability to self-monitor the access site visually and control bleeding with digital pressure

Interventionists cite:

1. Less bleeding risk
2. Less radiation exposure
3. Ability to work on both legs via single access
4. Ability to approach lesions in antegrade fashion (lessening risk of dissecting across the profunda femoris, the origin of the hypogastric artery, or the contralateral common iliac origin when crossing total occlusions that extend to the side branch)
5. No compression of the treated artery at procedure completion
6. Anatomical reasons

Disadvantages of radial access include:

1. Smaller vessels limiting sheath size
2. Need to traverse the radial, brachial, subclavian, aorta, iliac, and femoral vessels
 - a. Radial artery loops may be problematic
 - b. Obstructive lesions may be difficult to cross and may result in the sheath being occlusive of flow to the arm
 - c. In type 3 aortic arches, must be able to direct the guidewire into descending aorta
 - d. Must avoid injuring side branches including, but not limited to, the internal mammary arteries, vertebral arteries, and carotid arteries
 - e. Arterial spasm is more common (avulsion of radial vessels has been reported with forceful sheath removal)

3. Patient should have a patent radial palmar arch with collateral flow
4. Less backup support to cross total occlusions (particularly with type 3 arches, where the sheath may prolapse into the ascending aorta)
5. Incomplete portfolio of treatment tools
6. Risk of cerebrovascular embolic sequelae (increased in long cases, particularly if the sheath is occlusive of the proximal vessels and clot occurs)
7. Less bailout options available (ie, covered stents for iliac perforation)
8. Longer wires may become contaminated; wire and catheter exchanges take more skill

I strongly believe that most complications that have been reported with a radial approach can be avoided with appropriate technique. I have highlighted 13 easy steps that I have used in my practice that I think may be helpful to new operators utilizing radial access to improve success and limit complications.

Step #1: Assess the radial artery

This is one of the most important of all the steps.

1. I always perform ultrasound assessment prior to intervention to ensure the vessel is patent and is 2 mm or greater in diameter (which is the diameter of present sheaths). I assess arterial flow in the arm by duplex ultrasound to determine if there is a proximal obstruction. I do not use this access site if the radial artery is less than 2 mm, as the sheath will be occlusive and peripheral vascular procedures are typically more prolonged than coronary cases. If there is evidence of a proximal obstruction, I will not use this access unless I plan to treat that obstruction.
2. I always perform an Allen's test to ensure adequate collateral flow. If unsure of the results, place a pulse oximeter on a finger during a procedure to monitor adequate hand perfusion during the procedure.
3. I obtain patient height to ensure that the devices chosen are long enough to treat desired areas.
4. These tests will exclude most of the patients who should not have radial access.

Step #2

I like to set up the angiographic suite with long, covered tables (sometimes 2 tables) to facilitate using long wires. This will help avoid contamination during exchanges. At this point, I anesthetize the site of intended radial artery puncture. I use a mixture of 1% lidocaine (5 cc) and I.V. nitroglycerin at a concentration of 200 mcg per cc. I draw 5 cc of this as well and combine this mixture of 10 cc and administer approximately 5 to 6 cc along approximately 6 cm of the radial artery to limit pain and the potential for arterial spasm. In the average-height patient, approximately 10 cm of additional reach can be obtained if left radial artery access is chosen.

Step #3

Ultrasound-guided radial artery access followed by wire advancement under visualization with a micropuncture needle (never forcing the wire). Subsequent placement of a low-profile 10-cm sheath.

Step #4

1. Administer intra-arterial "radial cocktail":
 - a. heparin
 - b. nitroglycerin (200 ug)
 - c. calcium channel blocker (typically verapamil or nifedipine)
2. Buffer the cocktail by aspirating blood into the syringe and mixing it with the injectate. If this buffering is not done, the patient will note discomfort with the cocktail injection.

Step #5

1. Carefully advance a .035" flexible hydrophilic wire with a 3-mm J-tip to navigate the brachial, axillary, and subclavian arteries. This allows for navigation through radial loops and avoids side branches (**the wire should never be forced against resistance**). Monitor wire advancement with fluoroscopy.
2. If the superficial femoral artery (SFA) and popliteal or infrapopliteal vessels are targeted for intervention, I like to use a very long wire from the start so I can place sheaths and catheters without additional wire exchange.
3. If the wire meets resistance at any point, angiographic assessment of that area can help identify an area of stenosis or occlusion. If there is an obstructive lesion, do not place the longer sheath across these areas, as this may result in arterial thrombosis during long cases.

Step #6

Once the guidewire has entered the aortic arch, it may advance into the ascending or descending aorta. Observe in a 30-degree left anterior oblique angulation. If required to get into the descending aorta, utilize an angled catheter such as a pigtail to direct the wire into the descending aorta under visualization.

Step #7

1. If treating renal or visceral vessels, advance a guiding catheter to the treatment site over the guidewire.
2. If treating SFA/popliteal lesions in an average-height individual, advance a sheath of approximately 120-cm length to deliver treatment devices.
3. If treating infrapopliteal vessels, advance a 150-cm sheath.
4. Always hydrate the sheath with wet sponges while advancing in the radial artery to facilitate low-friction sheath passage.
5. Never forget that the delivery shaft of a device must be longer than the sheath.

Step #8

Once the sheath is in place, it should be aspirated, then flushed. The lesion to be treated should cross with the intended crossing wire with a support catheter long enough to cross the lesion to facilitate wire exchange if necessary. In stenotic lesions, if the intended crossing and treating wires are the same, just use 1 wire. If there is a tendency toward sheath prolapse, use wires with greater shaft support.

Step #9

If required, exchange a crossing wire for a device delivery wire.

Step #10

Perform frequent sheath flushes and carefully monitor activated clotting times. Stagnant blood in long sheaths is much more likely to clot; this can result in catastrophic sequelae. Always aspirate before any injection. If unable to aspirate, there is probably clot. Remove the sheath and flush outside the body, then reintroduce the sheath; the wire must be left in place.

Step #11

Deliver the intended therapy (limited devices at present):

- a. Multiple balloons have delivery lengths of 200 cm.
- b. Presently, there is only 1 self-expanding stent available with a 200-cm delivery length.
- c. Orbital atherectomy is available in a 200-cm length (the only atherectomy device long enough to reach most lesions).
- d. The longest drug-coated balloon available now is a 150-cm delivery length and infrequently is not long enough to treat the entire segment.
- e. Thin-walled hydrophilic sheaths of approximately 120 and 150 cm lengths allow radial artery access.

Step #12

1. Upon completion of treating the area, aspirate the sheath then withdraw it over the guidewire. Replace with a 10-cm sheath. I suggest placing the long dilator in the long radial sheath to aid in withdrawal.
2. If there is resistance to withdrawing the sheath, there is spasm. Never forcefully withdraw, as this can potentially avulse the vessel. If spasm occurs, aggressively sedate and administer medications to alleviate spasm to allow ultimate sheath removal. Patiently wait until spasm has abated. In my experience, by numbing a long segment of a radial artery initially and not forcing devices, I have not had to deal thus far with severe spasm.

Step #13

1. Perform vascular closure with compression (this can be manual or mechanical).
2. Monitor distal flow to avoid thrombosis of the radial artery.

Radial artery access is a viable option in many patients requiring peripheral arterial interventional therapy. The use of this approach is limited by the lack of a full armamentarium of tools, vessel size, angiographic suite configuration, and operator training and comfort. I strongly suspect that it will be used more frequently as more tools are developed and patients request this approach. This has already occurred with coronary interventions. The push toward outpatient intervention with same-day discharge may also fuel growth. Device miniaturization could further promote use, as procedures could be performed via smaller arteries.

Newer types of access are often met with criticism. This was the case with coronary radial access and tibial access cases. Despite initial pushback in coronary interventions, radial access, and peripheral interventions, pedal access has grown dramatically. Interventionists must be facile with all forms of access. The choice of access is crucial in achieving successful restoration of blood flow and in limiting complications.

Every type of access has advantages as well as disadvantages. Understanding where problems arise with each site of access is paramount in avoiding complications. The “Thirteen Steps to Avoid Radial Artery Access Complications in Peripheral Interventions” is meant to serve as a practical guide for those who are incorporating radial artery access into their practice. ■