

Navigating Vasculature via the Radial Approach

Challenging anatomic variations that operators should plan to encounter during transradial interventions.

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The radial artery is increasingly used as the preferred access route for percutaneous coronary intervention throughout European and Asian countries and is likely to become the default access site used by a majority of interventional cardiologists in the future. Compared to the conventional femoral access, radial access is associated with fewer complications at the vascular access site, greater cost effectiveness, more immediate ambulation, and better postprocedural comfort for the patient. Although a significant learning curve must be acknowledged, once it is passed, transradial procedure failures are infrequent and those that occur are related to rare puncture failure, radial spasm, or more frequently, to anatomical variations that require specific catheter handling. Physicians who are interested in developing a transradial approach program must expect these anatomic variations and be aware of the technical recommendations for overcoming such findings during the procedure.¹

ARE RADIAL ARTERY ANOMALIES A MAJOR CAUSE OF TRANSRADIAL PROCEDURE FAILURE?

Recently, a multicenter, prospective study was conducted in the United Kingdom with 1,540 individuals undergoing a radial procedure for the first time.² Among the cohort, only seven cases of radial puncture failure occurred; retrograde arteriography was performed in the remaining 1,533 patients. The researchers concluded that anatomic variations are frequent—present in as many as 13.8% of patients—and that they are significantly associated with higher procedure failure rates than in patients with “normal” anatomy (14.2% vs 0.9%, respectively; $P = .001$). The clinicians listed three major anatomic variations—high radial artery bifurcation, radial artery loops, and tortuous radial artery—and identified radial artery loops and tortuous radial artery as the main causes of procedural failure. In experienced centers, failure of the

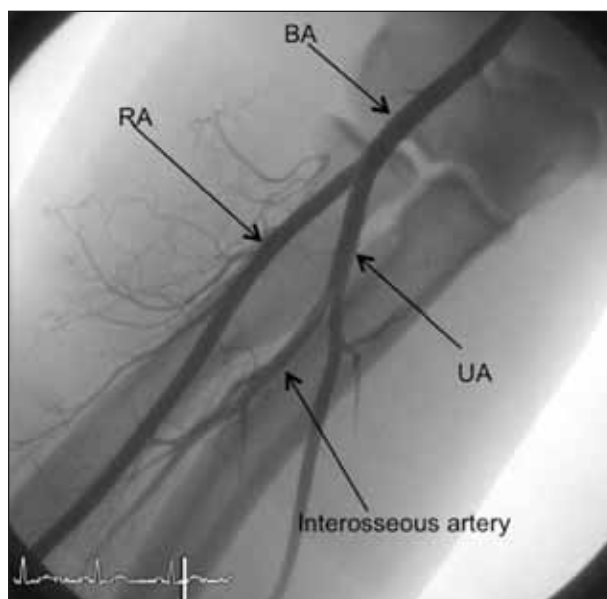


Figure 1. Normal radial anatomy. BA, brachial artery; RA, radial artery; UA, ulnar artery.

transradial approach due to anatomical variations is rare, and there are specific tips and tricks that may be particularly useful in overcoming these variations.

ANATOMICAL VARIATION IN THE RADIAL ARTERY AND THE UPPER LIMB ARTERIAL TREE

High Takeoff of the Radial Artery

Figure 1 shows the normal anatomy of the radial artery. High radial artery takeoff or bifurcation, as certain authors have mentioned,² is frequent, but operators often underestimate its challenges because they encounter no difficulty when the artery is large and do not need arteriography to identify the specific anatomy. In the standard classification of type 3 high radial takeoff (Figure 2), which is associ-

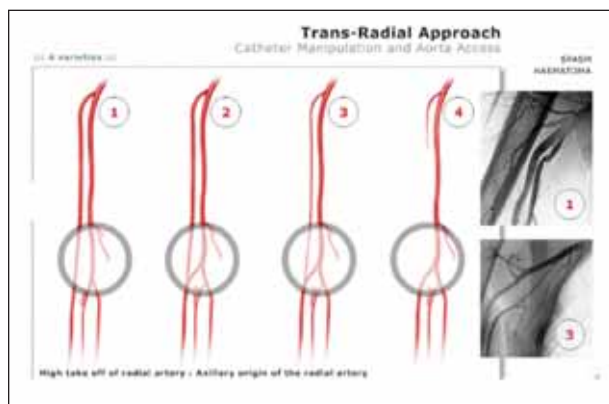


Figure 2. High takeoff of the radial artery (high bifurcation). Type 3 is associated with radial access failure. In this variation, the remnant radial artery with a small arterial diameter cannot be catheterized and is very prone to developing a spasm, as shown in the bottom right image.

ated with a remnant radial artery or a slender radial artery, the diameter of the radial artery precludes passage of the catheter (even 4 F) in most cases. Progressing with the catheters in such a remnant radial artery is painful for the patient and is associated with spasm and risk of perforation. Considering an alternative access site is frequently preferable in this case. There is no symmetrical anatomy regarding the arterial tree of the upper limb, so contralateral radial access is always a possibility to be considered in this setting. Of course, conventional femoral access is also the classical access site if an alternative is required.

For experts in transradial intervention, assessment of radioulnar anastomosis is the second step after angiographic diagnosis of the high takeoff radial artery origin. Some of these anastomoses are easily negotiated (Figure 3), and when there are loops of large diameter with large vessels, hydrophilic wires and plastic wires can cross the loop with an accordion effect of the artery above the catheter. Crossing this anastomosis between the radial and ulnar arteries allows the operator to reach the brachial artery directly to continue the procedure.

Loops and Tortuosities

As depicted in Figure 4, resistance to wire progression is sometimes caused by tortuosities at different levels: the radial artery, the brachial artery before the subclavian artery, and the brachiocephalic trunk. As some authors have acknowledged,^{1,2} these tortuosities are more frequently encountered in older patients and in patients with a long history of hypertension. Again, plastic wires and percutaneous coronary interventional wires can be useful here.

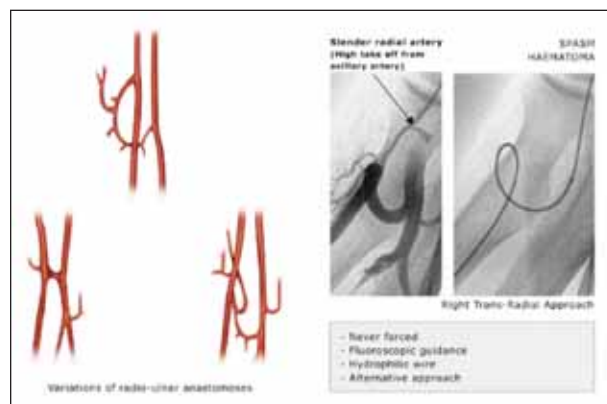


Figure 3. Radioulnar anastomosis variations needing evaluation in cases of high takeoff of the radial artery when the radial artery is slender. In this example, as shown in the angiograms (right side of the figure), the large vessel loop connecting the radial and ulnar arteries has been successfully crossed, allowing a successful transradial intervention.

Head and Neck Arteries

A special note of caution is appropriate to include about this anatomy, especially when the right transradial approach is used. Systematic fluoroscopy is required for crossing the subclavian artery and the brachiocephalic trunk to ensure that the wire and catheter are going into the descending aorta and to avoid penetration of the right carotid or vertebral arteries (Figure 5). This is particularly critical in patients with polyvascular disease, who have several risk factors and advanced age, because multifocal atherosclerosis disease can be expected. Again, the catheter should never be forced; a hydrophilic wire or percutaneous coronary interventional wires should be used if needed, and the patient should take deep breaths during attempts to reach the ascending aorta. This last maneuver is very useful to facilitate correct orientation and place-

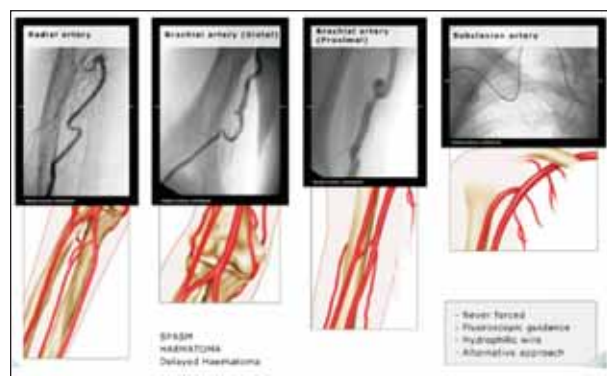


Figure 4. Examples of tortuous arteries at different levels in the upper limb arterial tree that were successfully crossed during transradial coronary interventions.

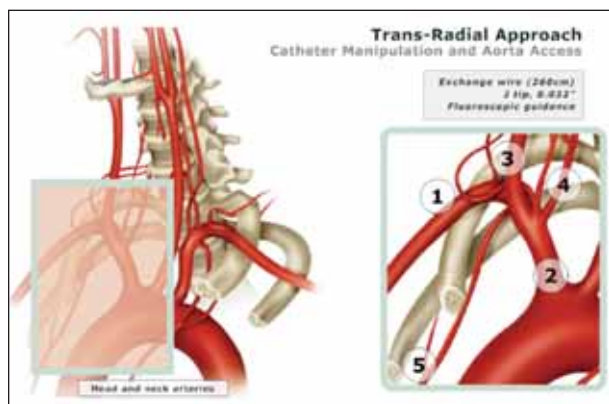


Figure 5. Head and neck arteries. The right transradial approach requires systematic fluoroscopic assessment when wires and catheters cross the subclavian artery and the brachiocephalic trunk. 1, indicates the right subclavian artery; 2, the brachiocephalic trunk; 3, the right carotid artery; 4, the right vertebral artery; 5, the right thoracic (or mammary) internal artery.

ment of the catheter in the ascending aorta. One must keep in mind that in patients with long histories of high blood pressure and in patients of advanced age, such as octogenarians, the brachiocephalic trunk and subclavian arteries sometimes present with a considerable amount of tortuosity that can make the procedure more complex.

From Brachiocephalic Trunk to Ascending Aorta

The respiratory maneuver—asking the patient to take a deep breath to facilitate placement of the wire and catheter inside the ascending aorta—is a key point. Elongation of the aortic arch is also frequently associated with a history of high blood pressure, and advanced age can also complicate a right radial approach. For patients with tortuous vessels in this high-risk subgroup, left radial access may facilitate catheter placement in the ascending aorta.

Finally, the arteria lusoria (retroesophageal right subclavian artery) is a unique anomaly that merits special attention (Figure 6). This anatomical variation is rare, but it requires rapid diagnosis because either left radial access or an alternative approach using a femoral route will be required.

SPECIFIC DEDICATED CURVES IN TRANSRADIAL INTERVENTIONS?

No specific curves are required to perform transradial percutaneous coronary interventions, even in these cases of anatomic variation. In keeping with the smaller diameter of the radial artery (compared to the femoral artery), smaller guiding catheters (5 F) are typically employed, as well as 6-F guiding catheters, which are used in cases of kissing balloon procedures or in those with other special requirements.

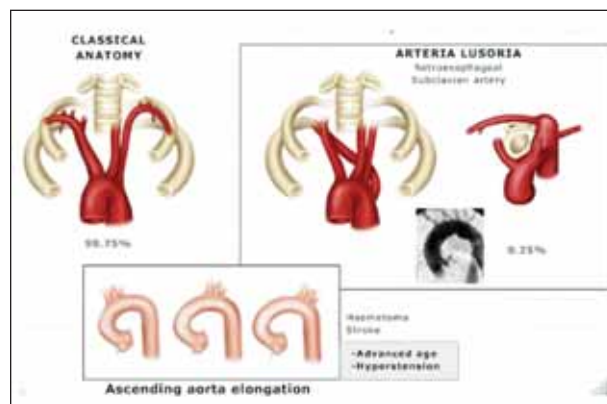


Figure 6. Specific difficulties using right transradial access include the rare arteria lusoria variation and elongation of the ascending aorta that is frequently associated with advanced age and a history of hypertension. To avoid longer procedural times, multiple catheter exchanges, and increased risk of forearm hematoma and ischemic stroke, an alternative approach is highly recommended in this clinical setting.

Decreasing the diameter of the catheters will reduce the risk of arterial injury, spasm, and subsequent radial occlusion. A recent international survey reported that classical curves were used in all centers worldwide and that there was no current role for dedicated curves.³

CONCLUSION

Operators should expect anatomical variations and have a plan to overcome these issues, which are frequently not complex. In the vast majority of cases, caution in advancing wires and catheters, angiographic assessment, and the use of specific wires as previously described in this article will allow a successful transradial intervention. In cases of high takeoff of the radial artery associated with a remnant of slender radial artery, an alternative approach, such as femoral access or contralateral radial access, is preferable given that these anatomic variations are rarely symmetric. ■

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