Beyond Radial: Ulnar, Snuffbox, and Palmar Branch Access

A review of the limitations of transradial access and the benefits and challenges of alternative approaches for cardiac catheterization.

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Despite the emergence of radial artery catheterization, transfemoral access (TFA) remains the most common route for patients undergoing interventional procedures in the United States. However, there has been a growing interest in radial artery catheterization for coronary angiography and intervention in the last decade in the United States due to major and minor vascular complications related to the transfemoral approach. Coronary angiography via the radial approach was first described by Campeau in 1989. In 1993, the first transradial percutaneous coronary intervention (PCI) was described by Kiemeneij and Laarman. Since then, several studies have emerged to compare transradial access (TRA) to TFA for cardiac catheterization. Studies including RIVAL and other multiple meta-analyses have shown a significant reduction in bleeding and vascular complications with TRA compared to TFA for PCI.

However, Carvalho et al reported a radial to femoral artery conversion rate of 5.8%, with predictors of failure including subclavian tortuosity, significant disease, accessory radial arteries, radial loops, and spasm. These factors may reduce the chance of successfully completing the procedure through the radial artery, requiring conversion to TFA. Cardiac catheterization through the radial artery requires expertise and has a learning curve. Therefore, the emergence of alternative arterial access sites has gained attention, with an increasing amount of research being performed to assess their applicability for routine use.

ULNAR ARTERY ACCESS

The ulnar artery is usually larger than the radial artery, has a straighter course, and is less likely to have arterial loops. The ulnar artery is the principal source of blood to the forearm, and anatomically, it passes inferomedially deep to the median nerve and accompanies the ulnar nerve. The arm is prepped in a similar fashion to TRA preparation; the hand is supinated with the wrist extended. However, the depth of the ulnar artery makes achieving access and hemostasis a challenge. Current vascular compression bands designed for the radial artery have been successfully used to achieve hemostasis.

Transulnar access (TUA) was first evaluated in cases with ipsilateral radial artery occlusion (RAO). Kedev et al evaluated the safety and feasibility of TUA in a single-center prospective registry. In 476 patients, with documented RAO in 240 patients, procedural success was 97% with a 3% crossover rate to TFA. None of the patients had ulnar nerve injury. Forearm hematoma developed in two patients, severe spasm occurred in two patients, and asymptomatic ulnar artery occlusion was detected in 3.1%.

Several studies support the safe use of the ulnar artery as an alternative to the radial artery for cardiac catheterization access. A recent meta-analysis by Fernandez et al compared TUA to TFA. In six trials with a total of 5,276 patients, there was no difference between the two groups in terms of complications, which included hematoma formation, pseudoaneurysm, and arteriovenous fistula formation, although access site failure was more than twice as likely with ulnar access (odds ratio, 2.63 [2.07–3.34]).

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Another example of using TUA includes a patient who underwent a valve-in-mitral annular calcification transcatheter mitral valve replacement utilizing a 29-mm Sapien 3 valve (Edwards Lifesciences) for severe degenerative mitral stenosis. The patient required an alcohol septal ablation days later to reduce the left ventricular outflow gradient. The radial artery was palpated and found to be very small. As illustrated in the forearm angiogram (Figure 1), the ulnar artery was larger. The ulnar artery was used to successfully perform the procedure with no complications, illustrating that the ulnar artery is a safe and feasible alternative to an inadequate radial artery.

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**DISTAL RADIAL ARTERY ACCESS**

Distal TRA has been of growing interest among radial operators given the improved ergonomics and the accessibility of the patient’s hand. Kiemeneij, inspired by work underreported by investigators in the Russian Federation and Iran, introduced many in the United States and Europe to TRA and distal left TRA. Distal radial artery access lies in the anatomic snuffbox of the hand, and in good candidates, it can be successfully accessed and cannulated (Figure 2A). Ultrasound (US) guidance may be valuable given the narrow window of access just before the artery dives into the wrist. The wrist and dorsum of the hand are both exposed and prepared, and access can be achieved on the left side of the patient. The arm can then be brought over the body to complete the procedure while maintaining the position of standing on the right side of the patient.

Accessing the radial artery in the snuffbox facilitates a better arm position for the patient as well as improved ergonomics for the operator. As compared with right distal TRA, catheters are thought to better engage the coronaries as they traverse the aortic arch from the left distal radial artery, mimicking the femoral approach. Hemostasis can be achieved in several ways. In many studies, it was achieved by applying a traditional vascular band used for conventional TRA (Figure 2B). This allows the hand to flex at the

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**Table 1. A Comparison of Upper Extremity Arterial Access Sites**

<table>
<thead>
<tr>
<th>Access</th>
<th>Advantages</th>
<th>Disadvantages</th>
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| Conventional radial artery access     | • Straight course in the wrist  
• Data support use over femoral artery in ACS/STEMI | • Radial loops  
• Accessory radial arteries  
• High risk for spasm  
• No LIMA access |
| Ulnar artery access                   | • Straighter course in the forearm  
• Less likely to spasm  
• Larger vessel | • Deeper vessel may make access and hemostasis a challenge  
• Close to the ulnar nerve  
• Limited data |
| Distal radial artery access (snuffbox) | • Improved ergonomics for both patient and operator with left-sided access  
• LIMA access with left-sided access  
• Preserves the proximal radial for future access | • Close to the scaphoid bone  
• Limited hemostatic devices  
• Tortuous as it dives in the wrist, which may be difficult  
• Steep learning curve |
| Superficial palmar branch access      | • Improved patient ergonomics  
• Preserves the radial artery for future access | • Small artery  
• Reported vascular complications  
• Variation in origin  
• Hemostasis may not be reliable  
• Limited data available |

Abbreviations: ACS, acute coronary syndrome; LIMA, left internal mammary artery; STEMI, ST-segment elevation myocardial infarction.

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Figure 1. Angiogram of the forearm, illustrating the course of the ulnar and radial artery. The ulnar artery is seen to be of larger caliber compared to the radial artery.
RADIAL ARTERY ACCESS

wrist, with no risk of hematoma.

Several studies have evaluated the safety and feasibility of this new arterial access. Kiemeneij described his experience with left distal TRA. In this cohort, the rate of failure to access the distal left radial artery was 11% (eight patients). There were no major bleeds from the access site. There was one reported distal left RAO, but otherwise, no proximal RAO was reported.

We evaluated our early United States experience in a cohort of carefully selected patients. There were no reported complications, and the rate of successfully completing the cardiac catheterization with PCI using the distal left radial artery without converting to a different access was 96.7%. The distal radial artery is small in many patients, which may make it unsuitable for access. Careful patient selection is warranted to achieve success in arterial cannulation. As the body of evidence grows, distal left TRA may prove that it is not a radial artery access eccentricity but a complementary addition to the current upper extremity arterial access for cardiac procedures. Further data are needed to better understand the long-term consequences and outcomes of utilizing the distal TRA for routine coronary angiography and intervention.

SUPERFICIAL PALMAR BRANCH ACCESS

Transpalmar access is another addition to the wide variety of upper extremity arterial access sites (Figure 3). This access has only been described in the literature by Roghani-Dehkordi et al as part of a case series. In 175 patients, the superficial palmar branch of the ulnar artery in the hand was accessed. The hand was hyperextended, and a 21-gauge needle was used to puncture the artery. A 0.018-inch guidewire was introduced, and sheaths ranging in size from 4 to 6 F were inserted. The success rate of accessing the superficial palmar branch was 90.8%. Complications including hand ecchymosis in two cases, hematoma of the proximal forearm in five cases, and hematoma of the distal arm in two cases were self-limited and did not require further treatment. Transient paresis and hypoesthesia were observed in seven cases in the fourth and fifth fingers, with complete recovery by 1 to 2 weeks. This was the only series quoting transpalmar access, as no other reports of this access have been found.

CONCLUSION

The three accesses described provide options for radial operators to add to their toolbox (Table 1). However, there is a learning curve. Patient selection and being well-versed in the anatomy is crucial for success. Further randomized controlled trials comparing different types of upper extremity arterial access sites to conventional radial artery access are needed to evaluate for significant differences in patient outcomes.


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