

## Chapter

# 12

## *Transradial Vascular Interventions — Expanding Indications and Increasing Safety*

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### BACKGROUND

The development of percutaneous procedure to diagnose and treat coronary artery disease has transformed lives of many patients.

The femoral artery has traditionally been the preferred site for coronary procedures, but this approach has got several limitations. This has led to the search for an alternative route. Since its first description in 1989 by Campeau et al, transradial approach is gaining popularity because it overcomes many of these limitations<sup>1</sup>. Transradial access has been used for cardiac catheterization and percutaneous coronary intervention (PCI) for more than 10 years.

The first transradial PTCA occurred in Amsterdam followed by the first transradial stenting in 1993<sup>2</sup>. This procedure now being widely used in several locations around the world.

### RATIONALE BEHIND RADIAL ARTERY ACCESS

The hand receives dual arterial supply from the radial and the ulnar arteries. Hence, the occlusion of the radial artery does not compromise the vascular supply to the hand, unlike femoral and brachial arteries. Furthermore the radial artery being superficial distally allows for easy compression of the artery<sup>3</sup>.

### APPLIED ANATOMY

The radial artery branches off of the brachial artery just below the level of elbow crease and passes on the lateral margin of the forearm until it reaches the level of the wrist. The vessel is deep to the body of supinator longus muscle in the upper part of the forearm. It lies between the tendons of the supinator longus and flexor



Fig. 1: Applied anatomy of wrist circulation

carpi radialis in the mid forearm down to the level of the wrist.

At the level of the wrist, the radial artery lies atop the scaphoid bone, the trapezium and the external lateral ligament. The radial artery in its distal course dives deep and lateral beneath the retinaculum, giving smaller superficial branches. It is therefore important to attempt cannulation approximately 2-3 cms from the flexion crease of the wrist.

At the level of the hand, the radial artery passes from the space between metacarpal bones of the thumb and the index finger into the palm. It crosses the base of the metacarpal bone of the little finger and communicates

with the deep communicating branch of the ulnar artery, forming the deep palmar arch. The superficial branch of the radial artery joins with the palmar portion of ulnar artery to form the superficial palmar arch.

Anatomical variations have been reported in around 12% of patients. The most common involves the radial artery originating just superior to the elbow, although in a few patients it may originate much higher in the arm.

The ulnar artery also branches off of the brachial artery and passes along the inner aspect of the forearm. At the level of wrist, it divides into two branches which communicate with the radial artery branches to complete the superficial and deep palmar arches.

It is not uncommon for a patient to display adequate ulnar and radial pulses and have abnormal plethysmography or Allen's test. Inadequate/incomplete palmar circulation or true radial or ulnar dominance has been reported in up to 10-23% of patients<sup>4,5</sup>. Patient who shows radial dominance should not be intervened upon from the radial artery.

### PREPROCEDURAL REQUIREMENTS

1. The wrist should be shaved (if necessary) and cleaned using strict aseptic precautions.
2. Groin should be prepared in addition, in patients in whom urgent IABP or temporary pacing is anticipated.
3. IV access should be taken in the contralateral arm or proximal to wrist if it is the same arm.
4. Allen's test or preferably oximetry/plethysmography should be documented in every patient undergoing a radial artery procedure.
5. A pulse oximeter should be placed on the index finger/thumb of the arm that is being intervened upon. This allows continuous assessment of the vascular integrity.
6. The wrist should be adequately cocked for better arterial access.
7. Armboard should allow for access at approximately 45 degree angle from the patient and the arm/wrist to be placed next to the patient.

#### Allen's Test

To perform this test, both the radial and the ulnar arteries are occluded so as to notice obvious pallor of the hand. Thereafter pressure on the ulnar artery is removed, while maintaining the radial artery

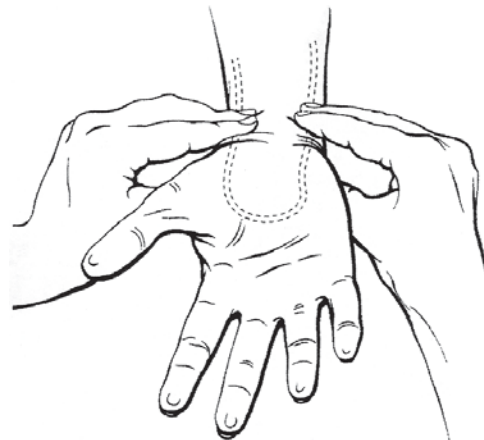


Fig. 2: Allen's test

pressure. Normally the colour of the hand should return within 8 seconds. Failure of the same indicates unsatisfactory collateral circulation.

#### Reverse Allen's Test

This is performed in patient who requires a second procedure through the same radial site. In this test the pressure on radial artery is released instead of ulnar artery, after both arteries are occluded. This test detects proximal radial artery occlusion or disease. Patients with abnormal reverse Allen's test should not undergo a repeat procedure via same site.

### TRANSFEMORAL VS TRANSRADIAL ACCESS

The transfemoral approach facilitates use of larger catheters/equipment and being technically easy has gained widespread acceptance. It is however, plagued with some inherent disadvantages like:

1. Prolonged bed rest required.
2. Use of closure devices increases cost.
3. It is more commonly associated with urinary retention, back pain, neuropathy than the radial approach<sup>6-8</sup>.
4. 0.5-4% incidence of vascular complications like pseudoaneurysm, AV fistula, transfusion, embolectomy.
5. Significant bleeding before it gets clinically detected.

These factors are overcome in transradial approach as it has got less access site complications. It has got several advantages like:

1. Lower incidence of limb threatening ischemia due to dual blood supply.

2. Advantageous in patients with severe occlusive aortoiliac disease.
3. Earlier ambulation. Hence of greater advantage in patients who are obese, have back pain and those who are in CHF.

The tendency of vessel spasm, inability to use larger devices/equipment and a different learning technique required for guide placement can be reduced with improved equipment and increasing operator experience.

### CONTRAINDICATIONS FOR RADIAL APPROACH

1. Abnormal Allen's test, oximetry/plethysmography.
2. Need for IABP, devices incompatible in  $\leq 7F$  sheaths like TEC, larger rotablator burrs, larger stents.
3. Upper extremity peripheral vascular disease.

### RELATIVE CONTRAINDICATIONS

1. Known IMA grafts contralateral to the site of entry. However, specifically designed catheters for IMA's through radial contralateral approach are available.
2. Conduit for CABG.

### EXPANDING INDICATIONS

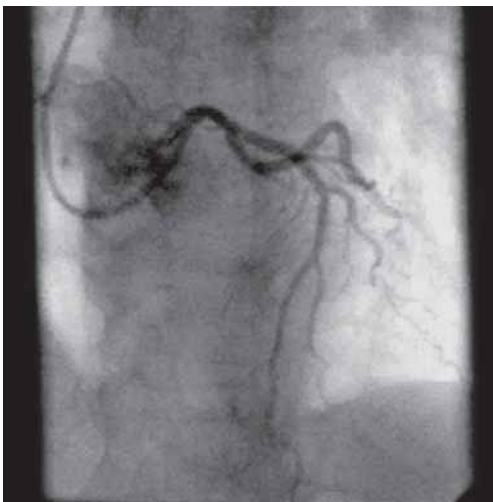
1. Transradial approach has been found beneficial and is associated with less access site complications in extremely obese patients.
2. Radial artery access is successful in patients who are anticoagulated (INR ranging from 2-4.5)<sup>9</sup>.
3. Primary and rescue PCI can be performed with high success rates using radial access. Although radial access was associated with a longer time to first balloon inflation, the difference was small and likely not clinically significant. Patients who are on glycoprotein IIb/IIIa inhibitors are at high risk of vascular complications. Radial access in these patients was not associated with any major bleeding complications as compared to femoral approach. There was no difference in contrast use and the fluoroscopy time<sup>10</sup>.

Radial approach in acute myocardial infarction is associated with less procedure time, hospital stay and bleeding complications<sup>11</sup>.

A systematic strategy of direct stenting via a transradial approach can be successfully adopted in the majority of patients undergoing single vessel PCI, both in elective and urgent cases, even when complex lesions and/or high-risk patients are treated.



Fig. 3: Kissing balloon technique by transradial approach



**Fig. 4:** Thrombus extraction by transradial approach

The exclusive use of wide inner-lumen guiding catheters in preformed curves allows performing stenting on bifurcations with no preclusion for the contemporary use of multiple balloons and stents (kissing-balloon technique)<sup>12</sup> (Fig. 3).

Thrombus extraction catheters can also be used via transradial approach in patients with acute myocardial infarction (Fig. 4).

4. In some specific circumstances, the radial approach may be superior to femoral access, rendering the procedure easier and faster. In approaching percutaneously lesions located in mammary artery bypass grafts, the shorter and more direct homolateral radial access is reasonably superior compared with the femoral one. To facilitate the coaxiality between the tip of the catheter and the axis of the mammary artery, dedicated modified guiding catheters have been successfully used<sup>13</sup>.

In some cases of anomalous takeoff of the coronary arteries, the upper approach from radial artery may offer some benefits. For example, in cases of target lesion located in right coronary arteries with anomalous origin from the left sinus of valsalva, successful direct stenting by right radial route has been described after failure of femoral approach<sup>14</sup>.

Finally, in the rare cases of stenting procedures in patients with critical atherosclerotic disease of one iliac- femoral axis requiring hemodynamic support (last remaining vessel interventions, severe depression of left ventricular function, etc.), the adoption of the radial approach may offer the opportunity to perform peri-intervention intra-aortic balloon counterpulsation through the contralateral femoral.

5. In the OCTOPLUS study, comparing the transradial and transfemoral approaches for coronary angiography and PCI in octogenarians, the incidence of vascular complications was found to be significantly less in the radial group (1.6% vs 6.5%,  $p=0.03$ ), without any decrease in the efficacy of PCI and only a slight increase in procedure duration for coronary angiography<sup>15</sup>.
6. The radial artery access site offers many advantages in neuroangiography. Right vertebral artery access is readily obtained from a right radial artery approach. As with cardiology procedures, neuro-radiology procedures may necessitate the use of lytic therapy or platelet inhibitor, sheath removal can be done without reversal of anticoagulation or concerns about major bleeding complications<sup>16</sup>.

## CONCLUSION

The radial artery approach is practical and safe for most of the percutaneous coronary as well as peripheral interventions. The choice of appropriate material and its availability is very important.

A learning curve has been reported and the procedure failure rates, time to sheath insertion, fluoroscopy time, and duration of procedure are all significantly reduced after experienced femoral operators have done more than 70-90 transradial coronary angiograms.

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