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Under the Beam

Transradial Interventions

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Introduction

As minimally invasive procedures are increasingly tailored for outpatients or same-day discharge, approaches for arterial interventions to reduce recovery time have evolved to meet this need. Transradial access (TRA) was introduced in Amsterdam by Dr. Lucien Campeau in 1989 during cardiac catheterization to provide an alternative to surgical cut-down (Almany & O'Neill, 1999). The first TRA coronary angioplasty was performed in 1992, and a year later, the first TRA coronary stent was deployed (Fischman et al., 2015).

Over time, TRA, as an alternative to transfemoral access (TFA), has been studied. The radial versus femoral randomized investigation in ST-elevation acute coronary syndrome (RIFLE) study conducted in 2012 by Dr. Romagnoli et al. evaluated 1,001 patients who underwent cardiac catheterization and revealed a 60% decrease in access-site bleeding, a 17.3% decrease in adverse clinical events, and reduced length of hospital stay (Romagnoli et al., 2012). Posham et al. studied 1,500 noncoronary TRA procedures in a heterogeneous patient population which included peripheral and visceral procedures and concluded that TRA was safe and well tolerated (Posham et al., 2016). Moreover, TRA has been studied specifically for both chemoembolization and radioembolization, revealing safety benefits, increased patient preference, decreased access-site complications, and lower costs (Kis et al., 2016 and Shiozawa et al., 2003). Increasingly, TRA is being adopted in interventional radiology (IR) practices. Herein, radial artery anatomy, preprocedural patient evaluation, how to perform the TRA, potential advantages, limitations/complications, and post-procedural care are discussed.

Radial anatomy

Most commonly, the radial artery arises from the brachial artery distal to the elbow and travels laterally in the forearm, superficializing at the wrist (Figure 1). Variant anatomy includes high takeoff of the radial artery, either directly from the axillary artery or from the brachial artery above the elbow (Almany & O'Neill, 1999). Occasionally, the radial artery contains a “loop” in its course. At the level of the wrist, the radial artery overlies the scaphoid and trapezium bones (Figure 2) and terminates in the palmar arch, where it usually anastomoses with the ulnar artery (Almany & O'Neill, 1999).

Although cardiologists generally access the right radial artery for the purposes of coronary angiography, the left radial artery is the preferred choice in IR as most IR procedures are subdiaphragmatic. Left TRA allows for a wire to traverse the radial, brachial, axillary, subclavian, and innominate arteries before reaching the aortic arch, descending aorta, and ultimately the vessel of choice (Figure 3) (Almany & O'Neill, 1999). This path avoids crossing the remainder of the major aortic vessels, decreases the distance to the descending aorta compared with the right radial artery, and most closely mimics right TFA access, the orientation most familiar to the IR community.

Patient evaluation

Before the procedure, patients are evaluated with a Barbeau test (a modified Allen's test) that determines ulnar-palmar arch patency and ensures adequate perfusion to the hand (Posham et al., 2016). To perform the Barbeau test, a pulse oximeter is placed on the patient's thumb, and the radial pulse and waveform are analyzed before and after 2 minutes of radial artery compression (Fischman et al., 2015). Changes in the waveform distinguish ulnar-palmar arch patency and are graded into 4 types of waveforms: (1) no dampening immediately after compression, (2) dampening, but a restoration of the waveform

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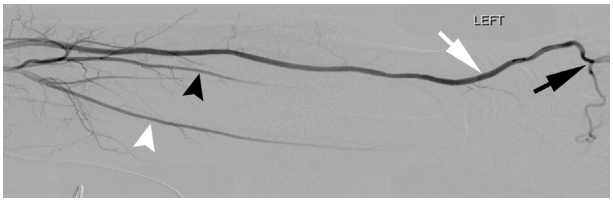

Figure 1. Digital subtraction arteriogram of the left lower arm. The radial artery (white arrow), ulnar artery (white arrowhead), and interosseous artery (black arrowhead) are the terminal branches of the brachial artery. The ulnar artery courses medially, whereas the radial artery courses laterally and gives rise to the palmar arch (black arrow).

to the pulse is dampened, (3) loss of pulse with recovery within 2 minutes, and (4) loss of pulse without recovery within 2 minutes (Fischman et al., 2015). Barbeau waveforms A, B, and C affirm ulnar-palmar arch patency, whereas the waveform D is contraindicating for TRA. Other contraindications include patients with a dialysis fistula or radial artery smaller than 2 mm (Fischman et al., 2015).

How TRA is performed?

After confirming patient candidacy for TRA and before bringing the patient into the procedure room, topical lidocaine cream and nitroglycerin ointment can be applied to the access site and left to dwell for 30 minutes. The patient is then brought into the room and positioned with the arm abducted 20–30° from the body, and if needed, the wrist may be shaved before standard sterile preparation (Figure 4). Using ultrasound guidance, a solution of 2% lidocaine and 100 mcg of nitroglycerin can be used to infiltrate the subcutaneous tissues around the radial artery to provide tumescent anesthesia and decrease the risk of vasospasm. Access into the radial artery is achieved approximately 1–2 cm central from the wrist using a 21-gauge needle and 0.018 guidewire. Then, a radial artery sheath (with tightly tapered tip, hydrophilic coating, and thinner walls than femoral artery sheaths) can be placed. A commonly used antispasmodic

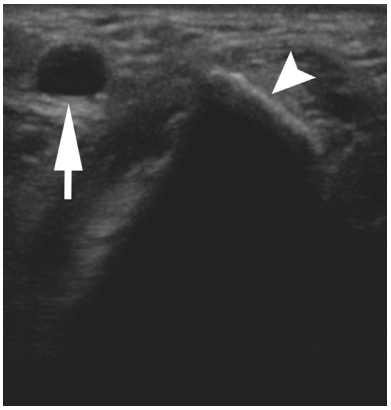

Figure 2. Gray-scale ultrasound image at the level of the wrist reveals how superficial the radial artery is to the carpal bones (white arrow).

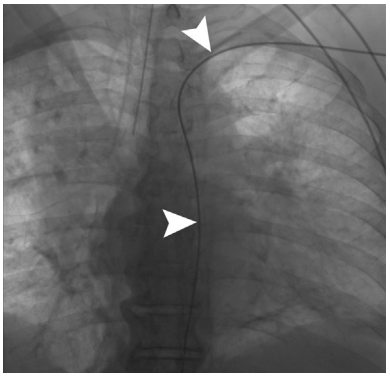

Figure 3. Intraprocedural spot radiograph of the chest reveals the course of the left transradial catheter coming up the left arm from the radial, brachial, and axillary arteries before turning at the subclavian artery (superior white arrowhead) and coursing inferiorly through the descending thoracic aorta (inferior white arrowhead).

cocktail consisting of 3000 units of heparin, 200 mcg of nitroglycerin, and 2.5 mg of verapamil is slowly injected through the sheath, which is secured with a dressing and is ready for use (Figures 5 and 6).

Advantages

TRA access has many potential benefits, including decreased risk of bleeding, hematoma, and pseudoaneurysm, compared with TFA access given the easy compressibility of the radial artery is particularly enticing in coagulopathic and morbidly obese patients. In addition, the immediate ability of patients undergoing TRA to sit upright, ambulate, or be discharged shortly after the procedure improve the patient's experience (Fischman et al., 2015). In small case series, prone positioning of the patient with simultaneous TRA has also been used to combine endovascular therapy and posterior percutaneous intervention (e.g., renal biopsy or ablation) in a single session without having to reposition the patient at the middle of the procedure (Figure 7) (Chick et al., 2016 and Srinivasa et al., 2018).

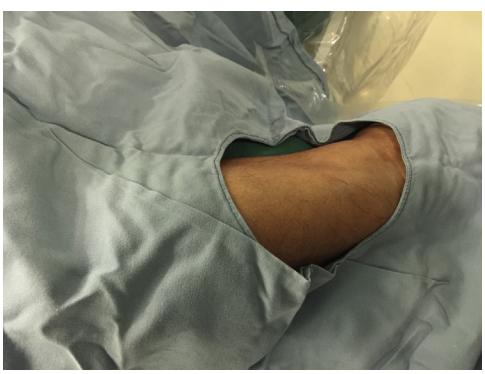

Figure 4. The wrist prepped and draped in standard fashion.

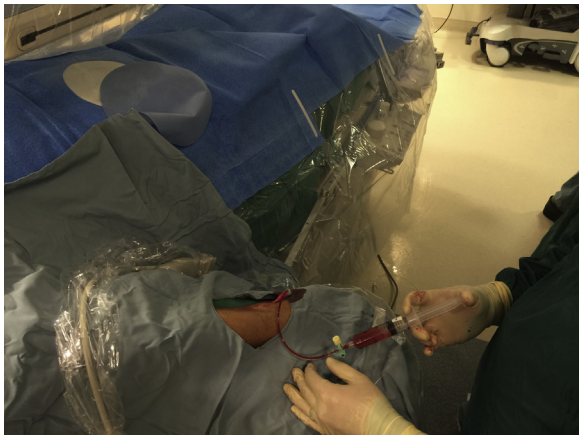

Figure 5. After left radial access is achieved and a sheath is placed, an antispasmodic cocktail (verapamil, nitroglycerin, and heparin) is hemodiluted with the patient's blood and slowly infused.

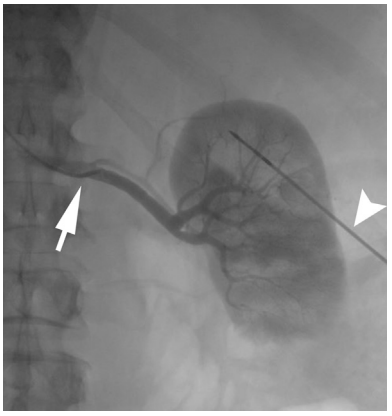

Figure 7. A 57-year-old male patient with left renal cell carcinoma. Spot radiograph of combined prone transradial arteriogram (white arrow) and simultaneous percutaneous microwave ablation (white arrowhead) of a superior pole tumor.

Limitations

Given the novelty of the TRA approach, many operators may not have encountered this technique during their training and will undergo a procedural learning curve. Moreover, IR suites were not originally designed for this approach, and the configuration of the suites may have to be changed. Departmental inventory changes are also necessary to incorporate the additional lengths and different catheter shapes used during TRA approaches. Note should be made that infrainguinal interventions may be beyond the reach of currently available devices. Finally, the sheath size from the TRA is limited to 7 French to minimize the risk of radial artery complications.

Complications

Complications with TRA are uncommon and can be minimized with appropriate patient selection and meticulous techniques. The most common complication from a TRA is a small hematoma. Other complications include radial artery occlusion, pseudoaneurysm, dissection, perforation, severe spasm, and radial arteritis (Fischman et al., 2015). Digital ischemia seldom arises but can occur in patients who have a Barbeau D waveform. Nerve damage is rare, although patients may report transient irritation or temporary numbness.

Postprocedural care

Unlike TFA closure devices, TRA hemostasis is achieved with manual pressure or one of many available hemostasis compression devices that hold pressure over the arteriotomy while maintaining a palpable radial pulse underneath (Figure 8). Patients are observed for at least 30 minutes and educated on aftercare before being discharged. Instructions to avoid flexion and extension of the wrist for the rest of the day should be given, as well as instructions to avoid of lifting more than 5 lbs (Almany & O'Neill, 1999). Swelling can be treated at home using ice and over-the-counter pain medication. If bleeding occurs, elevation of the hand along with pressure over the site will control the bleeding. Bleeding after the patient is discharged is easier to manage than rebleeding after a TFA (Almany & O'Neill, 1999).

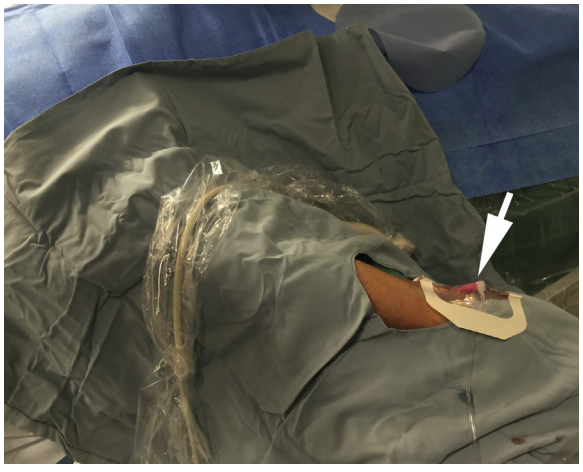

Figure 6. An adhesive dressing is applied over the radial sheath to help hold it in place (white arrow). This is particularly helpful during catheter exchanges as the hydrophilic sheath can inadvertently be removed.

Figure 8. TR Band (Terumo Medical Corp; Somerset, NJ) is an example of a commonly used radial artery hemostatic device, which can be inflated with air and then deflated and removed per protocol.

Conclusion

TRA is a promising alternative to TFA with potential patient benefits, cost savings, and decreased complication rates. Increasing familiarity is warranted as this emerging approach becomes more common in IR suites.

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