Distal Left Radial Artery Approach for Cardiac Catheterization: Advancements in Ergonomics With Techniques and Technologies

"When in doubt, snuff it out."

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Growing from 1% in 2008 to almost 40.6% in 2017[1], the radial approach is expanding in popularity in the United States. The use of the right radial artery (RRA) has been the preferred access route for interventional cardiologists due to familiarity working from the right side of the table and room setup.[2] The left radial artery (LRA) approach is usually ill-favored, because of poor ergonomics. For staff, it is time-consuming to construct a sterile field with eye drapes, clamps, towels, and Tegaderm. Sterility can be an issue, with multiple steps during preparation, and quite often, migration of drape fenestration. Some of the most prevalent obstacles for operators include reaching across the table to manipulate catheters and the left arm "drifting" away from the operator due to improper setup. Non-visualized or "hidden sheaths" occur because of the left hand's propensity to pronate during adduction across the body. This happens because the arm naturally circumducts when it is brought across the torso during LRA catheterizations. A combination of these factors can make a left radial approach incredibly uncomfortable and arduous. However, there are several documented advantages from the left radial approach when compared with the right, such as reductions in fluoroscopy time, contrast dose, operator radiation exposure, and stroke reduction, as well as an advantage noted by one study in needle-to-balloon time during acute myocardial infarction.[3-8] These advantages have primarily been attributed to better shield apposition during an LRA procedure and less tortuosity from the LRA approach[9-10] when compared to the right. In the OPERA study[8], the operator's radiation exposure via the LRA was less, regardless of operator experience.

Several new advances in left radial artery procedures with direct implications on operators and staff have made the LRA approach less difficult and more attractive. First, the distal radial artery approach, also known as the anatomical snuff box approach, is the cannulation of the terminal portion of the radial artery located between the extensor pollicis longus and the extensor pollicus brevis (Figure 1). This particular access site can make cardiac catheterization via the LRA easier on patients and operators. Pioneered by Dr. Ferdinand Kiemeneij[11], the distal radial artery approach is proving to be a game-changer for LRA cases. This technique has been widely dispersed through social media and is gaining popularity, so much so that some operators now use it as the default access site. Left arm access is also being offered by some interventional cardiologists as an access site for patients who prefer not to have their right radial cannulated. Dr. Matheen Khuddus at TCAVI (Gainesville, Florida) now routinely asks about hand dominance as part of the pre-catheterization protocol, and uses left distal radial access as the default approach for right-handed patients to avoid immobilization of the dominant hand in recovery and free use of their dominant hand post catheterization.[12] Second, devices such as the Radial Access Sleeve (Tesslagra Design Solutions) have proven to be invaluable to staff regarding sterility, reducing preparation time, and enhancing the ergonomics of a LRA procedure. Typical LRA prep uses a standard drape, towels, clamps, and Tegaderm. It takes approximately 7-9 minutes to construct a circumferential sterile field. The radial access sleeve takes approximately 1.25 minutes to prep for the LRA access site, which yields a significant time savings and offers a fast bailout method for right radial failure. A promising new left radial support device called the Cobra Board (TZ Medical) acts as a buttress to prevent arm "drift" and eliminate homemade support methods to adduct the instrumented arm (Figure 2). Integrating these particular techniques and technologies can potentially assuage the difficulties associated with the left radial approach and positively reshape its ergonomics.

Not only can the snuff box approach be used on the left radial, but this technique can be used on the right radial as well. In a large-scale study (n=2775) by Kaledin et al[13], efficacy and complication rates were observed in the distal radial artery and compared to standard (forearm) radial access (n=3099). The average diameter of the distal radial artery was 2.4 mm, significant because of the ability to accommodate a 6 French sheath. The rates of radial artery occlusion (RAO) from the snuff box approach compared with the standard approach were 2.2% vs 4.2% ($P<.05$), respectively. Dose area product (DAP) and fluoroscopy were not significantly different between both access points. All complications (hematoma, pulsatile hematoma, arteritis, dissection, rupture, arteriovenous fistula) were 0.2% or less. Distal forearm (standard radial access site) RAO after catheterization of the radial artery within the anatomical snuff box was observed in less than 0.5% of cases. This is interesting because the prevalence of standard RAO was reduced almost 10 times and the total number of occlusions was reduced twice.[13] The clinical significance is in the preservation of the standard radial access site for future procedures. Hemostasis can be achieved with a modified TR Band (Terumo) or "homemade" methods to apply pressure to the access site. This technique is not limited to cardiology; the uptake of the radial artery approach is increasing and several other specialties (interventional radiology, interventional neurology, vascular, etc.) have begun to adopt a radial approach, because of the benefits in terms of reduced bleeding complications and patient comfort. In the future, the distal radial artery approach may become a default access to preserve standard radial access sites for subsequent procedures.

Figure 1. Left distal radial or "anatomical snuff box" approach.

Figure 2. Radial Access Sleeve (Tesslagra Design Solutions) with Cobra Board (TZ Medical) (pre-cannulation).

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Figure 3. Wedged pillow into two toboggan boards for left arm support.

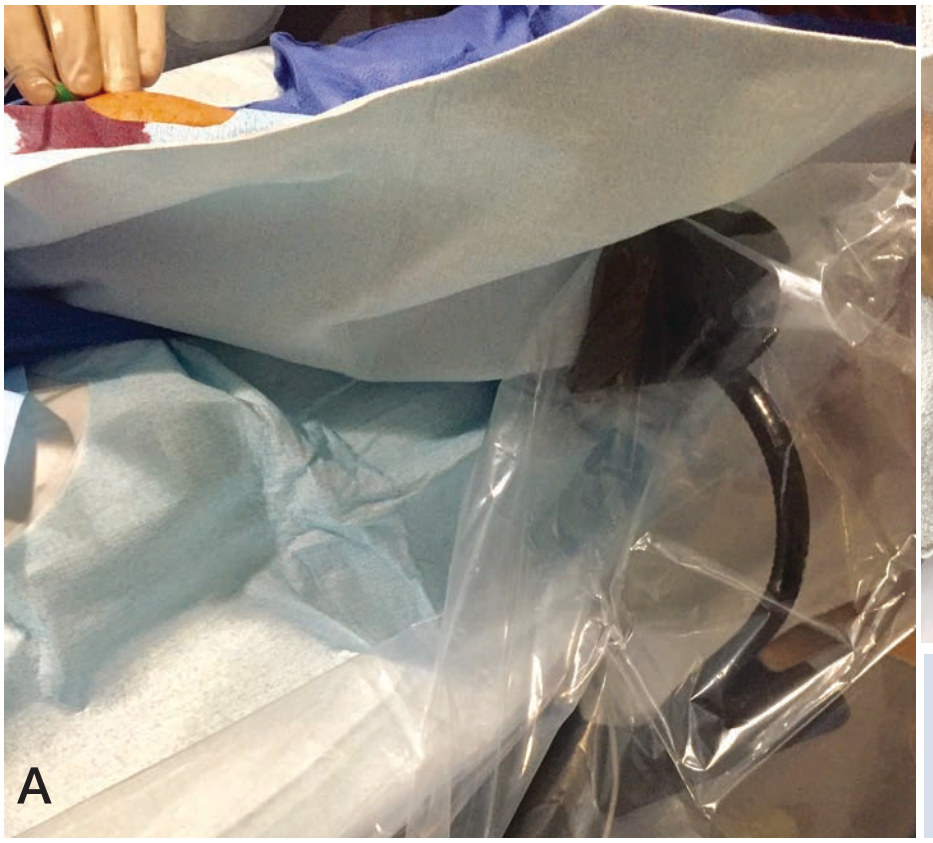

Figure 4A-B. Cobra Board in position to prevent arm drift.

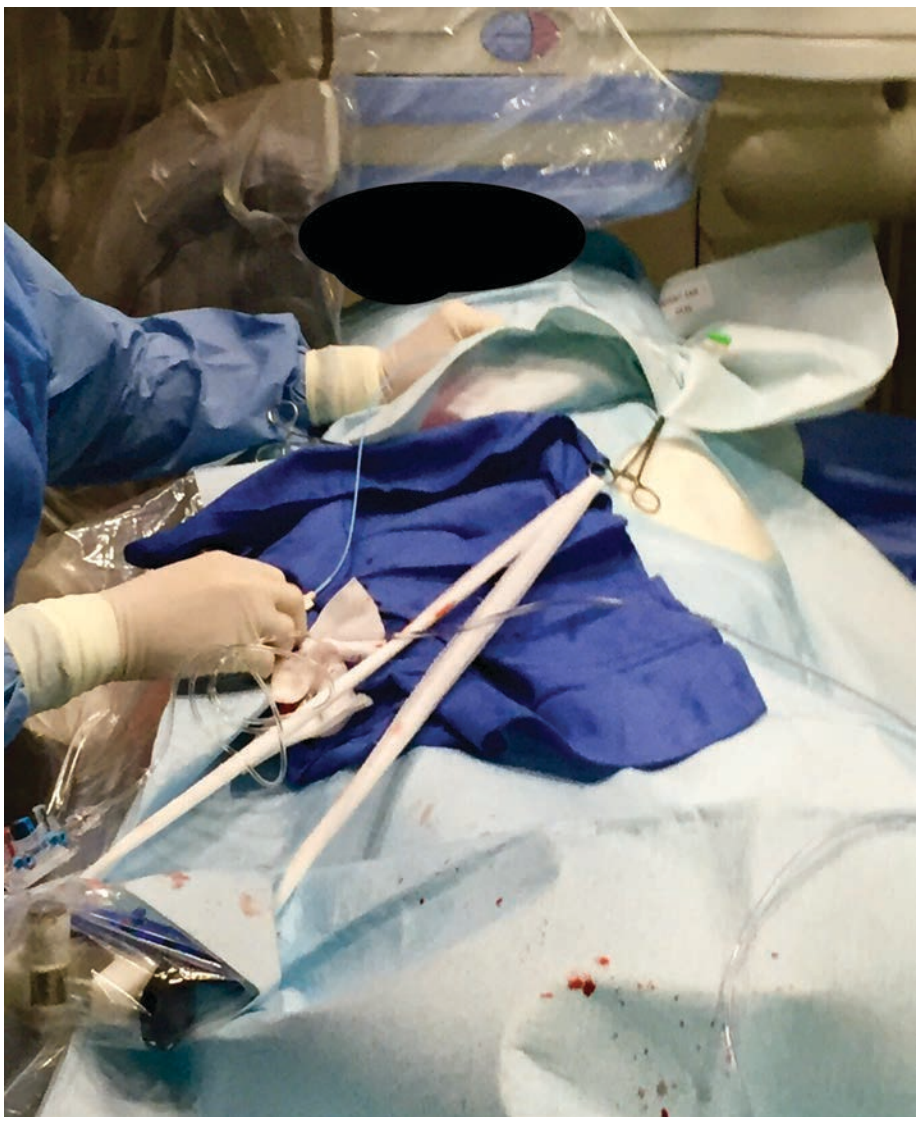

Figure 5. Three-foot gauze used to tether the left arm in place.

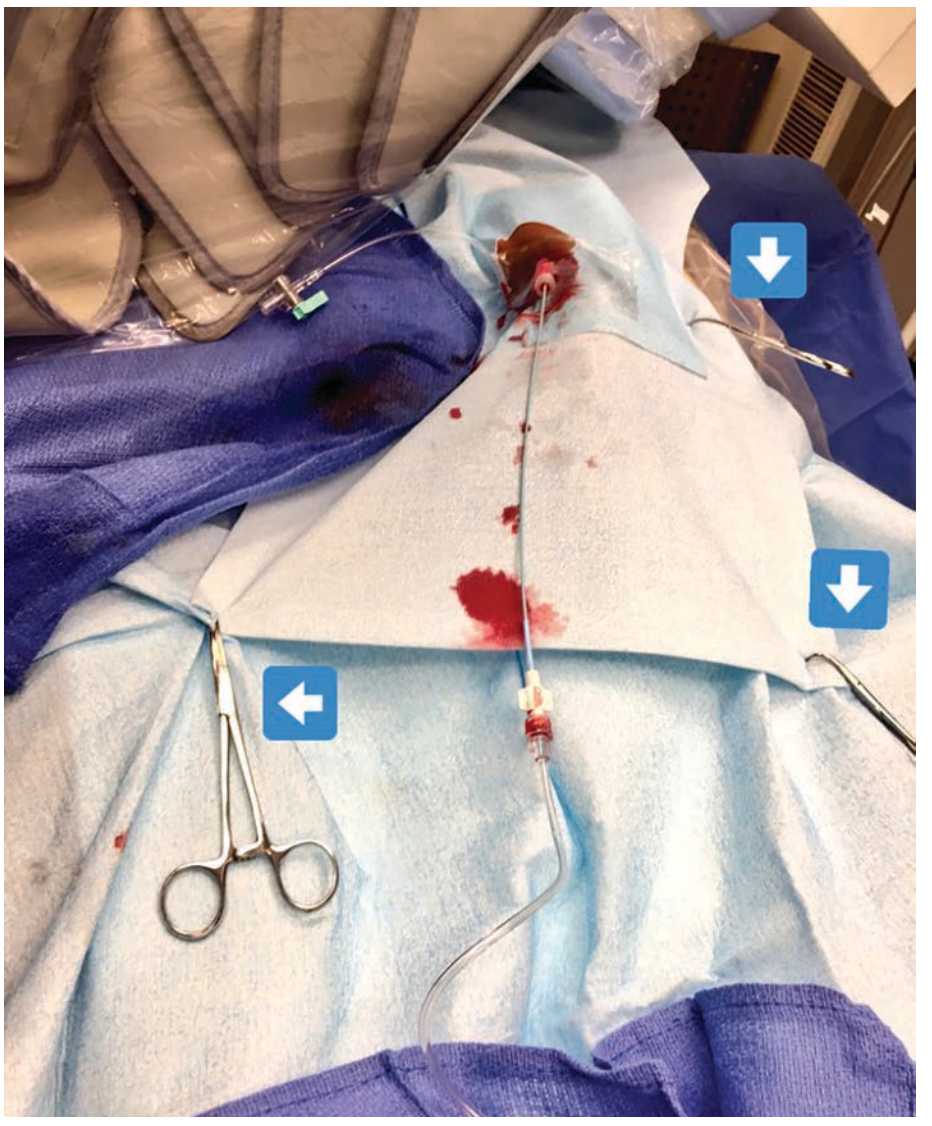

Figure 6. Strategically placed clamps to stabilize adduction and keep wrist supinated (standard LRA).

Problems, Setbacks of the Left Radial Artery, and Solutions With the Snuff Box Approach

1. **Problem:**
   a. **Prep.** Attain circumferential sterility of the left arm by enveloping the arm in a large eye drape in conjunction with towels and clamps to create a seamless closed field.
   b. **Setback:** Time-consuming, lessens ability to clamp to body drape, fenestration frequently migrates from radial site and becomes a sterility issue.
   c. **Solution:** A radial access sleeve has a design for circumferential sterility, reduces prep time, and allows for adequate clamping to body drape to aid in preventing arm drift and wrist pronation (may not change for the snuff box approach). The snuff box can be cannulated with the arm already adducted; however, the entry angle of the needle can be somewhat awkward reaching across the patient, amplified with moderate to severe obesity. Wrist flexion can be more common in this situation, which can lead to poor wire advancement and

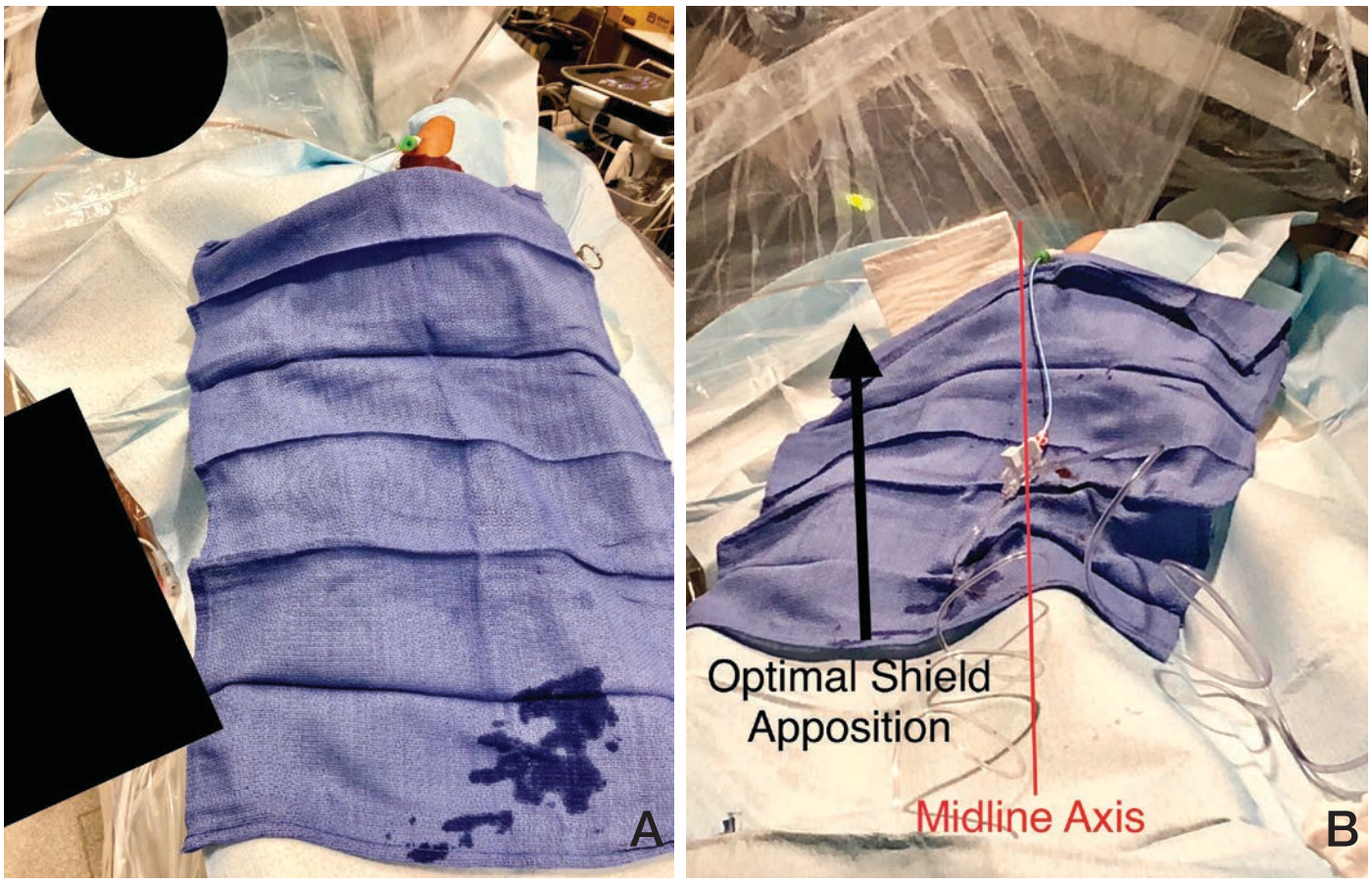

Figure 7A-B. Snuff box access on posterior surface of hand (operational view) with proper shield apposition.

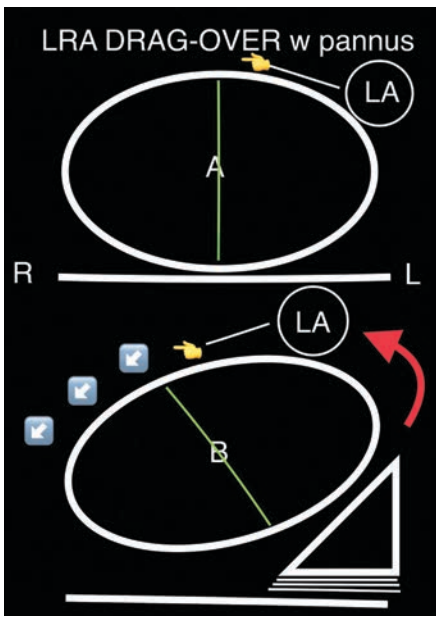

Figure 8. Schematic image. Turning patient slightly LAO to further left arm adduction.

kinked sheaths (particularly thin-walled sheaths). Cannulation with the arm abducted will optimize needle entry angle, increase operator comfort during access, and allow the operator to rotate the arm/wrist for ideal access position. These techniques may save time and reduce access attempts. Ultrasound-guided access is highly recommended. It takes approximately 50 cases to become comfortable with distal radial access.[13]

2. **Problem:**
   a. **Support.** Prior to prepping the patient, a support system to elevate the left arm should be in place. This can be accomplished with a wedged pillow into two toboggan boards (Figure 3). This essentially creates a platform for the arm to rest on.
   b. **Setback:** Does not accommodate all anatomies and doesn't always prevent arm drift.
   c. **Solution:** Dedicated buttress device or left radial arm board prevents arm "drift" and locks elbow/triceps in position for optimal operating ergonomics and patient comfort (Figure 4A-B). It conforms to the majority of anatomical variances. This technique does not change with snuff box approach.

3. **Problem:**
   a. **Adduction.** After cannulation (with arm abducted), adduct the arm so that the sheath is midline or just left of midline.
   b. **Setback:** Arm may fall back if improperly supported or if the patient is sedated, the arm may drift unconsciously.
   c. **Solution:** Tension applied by 3-meter gauze can be clamped or fastened to the arm, and secured to the right side of the table (Figure 5). Orthopedic finger traps can provide tension for a standard setup; however, these can be uncomfortable with extended amounts of time. A Kelly clamp attached to the body drape on the medial side of a sleeve device helps keep the arm adducted (Figure 6). The snuff box approach may aid with further adduction of the arm with increased patient comfort.

4. **Problem:**
   a. **Wrist Pronation.** The wrist will have a higher propensity to pronate with increased adduction.
   b. **Setback:** "Hidden" sheaths are a direct result of increased adduction, and operators continuously have to manipulate the wrist for control and visualization of the sheath.
   c. **Solution:** A long sheath with several centimeters left outside the body or a sheath extension can provide extra room to operate. Strategically placed clamps on the lateral side of the sleeve drape will supinate the wrist and also prevent "hidden" sheaths (Figure 6). The snuff box approach eliminates hidden sheaths completely, due to the location of the access site on the posterior surface of the hand (Figure 7A-B). It adds significantly to patient and operator comfort.

   i. The snuff box approach mitigates a considerable amount of the ergonomic problems associated with the LRA approach; however, obesity can still add a level of difficulty. One technique that has proven to be useful is turning the patient slightly to the left anterior oblique (LAO). Using a wedge or pillow, rolling the patient LAO will facilitate further adduction of the instrumented arm by raising the shoulder. Gravity will move the pannus towards the operator, allowing the arm to rest on the patient's left flank (Figure 8). Another useful tip, especially for shorter operators, is to use a small standing stool to alleviate any bending or reaching that can occur during LRA approach procedures. Some operators have adopted the method of working from the left side of the patient with the arm abducted 90 degrees. They work from a seated position with catheters extended onto an equipment table that is fastened to the arm board supporting the instrumented arm. This alleviates standing with lead on for extended periods of time; however, it lowers the head to the level of the primary source of scatter radiation, which may increase dose to the left side of the head, eyes, and thyroid. It may also become a logistical problem for catheterization laboratories with limited space and that have

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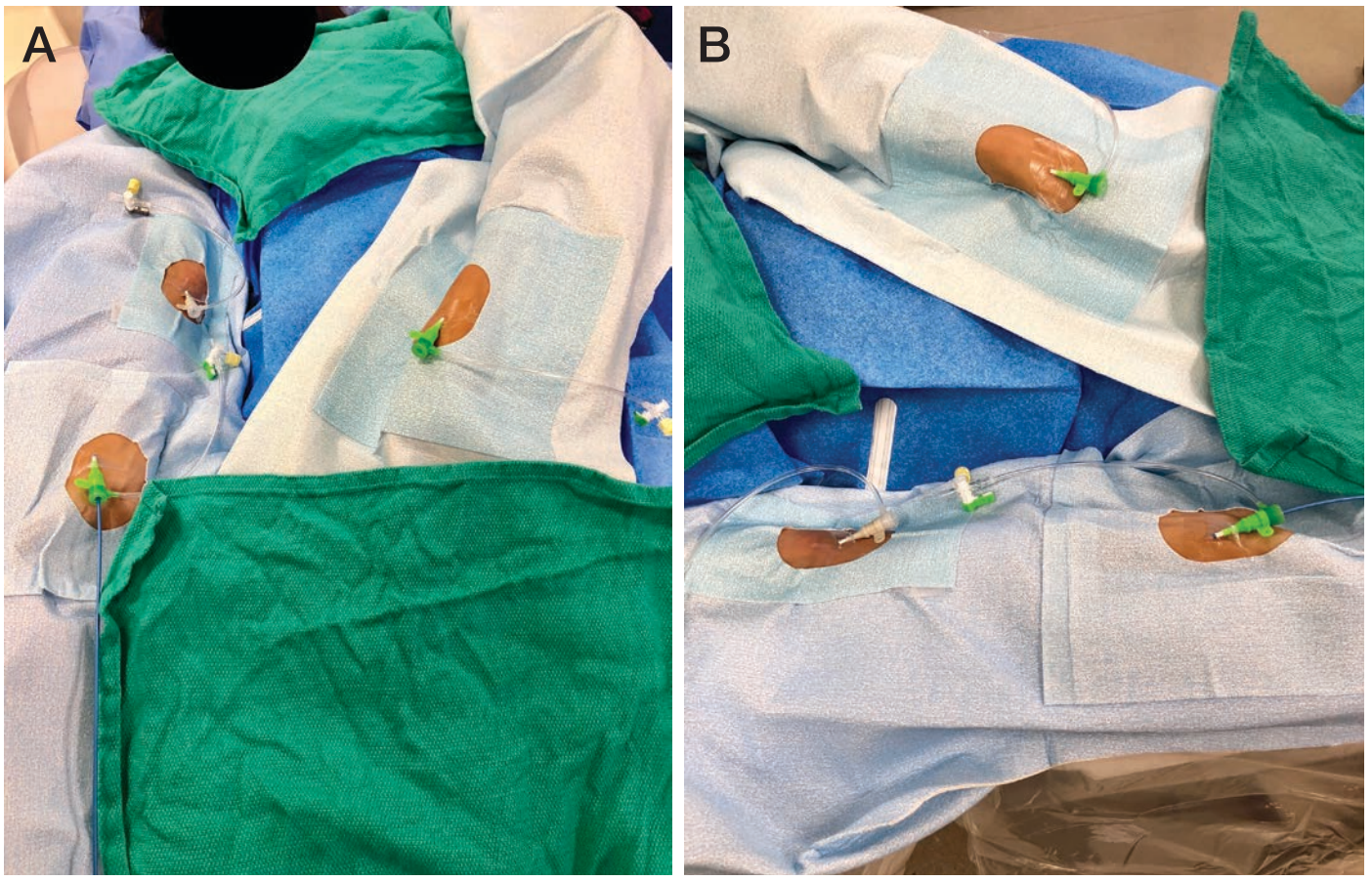

Figure 9A-B. Enhanced ergonomics with two sleeve technique for CTO. Left "snuff box" access, right radial artery access, and brachial vein access for right heart catheterization.

been designed to work from the right side of the operating table. Further investigation of this technique is warranted. There is also a push to do chronic total occlusions (CTO) bi-radially. Left snuff box access adds a level of positive ergonomics to already difficult cases (Figure 9).

ii. Obese patients with a higher body mass index (BMI) inherently require more radiation to generate diagnostic images. Historically, the LRA approach has proven to significantly cut operator radiation exposure. It may serve to use the LRA approach more liberally for obese patients, as it would reduce operator radiation exposure for patients that generate the most scatter radiation. In conjunction with known clinical predictors of innominate tortuosity (e.g. hypertension, short stature, female, >70 years of age, high BMI[14-17]), the LRA approach also becomes more appealing. It may seem like "cath lab heresy" to use the LRA approach for obese patients, but advances in techniques and technologies make these procedures more palatable, and more beneficial for operators and patients.

Conclusion

There are many sites to approach access for cardiac catherization. Mason Sones promoted the cutdown technique that was used into the 1980s. The percutaneous technique superseded the cutdown technique as supplies and equipment evolved to make a percutaneous approach safer and quicker, thus increasing patient satisfaction. The transradial approach has further increased safety, speed, and patient satisfaction, and the snuff box approach may offer an additional opportunity to accomplish these same goals. ■

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