Distal Transradial Access for Coronary Angiography and Interventions

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Abstract: Coronary angiography is one of the most common procedures done in the United States and in other developed countries. For decades, the femoral artery has been the most common vascular access site utilized for this procedure. However, the radial access has been gaining popularity for being a safer and yet practical vascular access with substantial benefits. More recently, the novel distal transradial approach has proven to be an equally or perhaps safer vascular access for diagnostic and interventional coronary and noncoronary procedures. This technique should be in every interventional cardiologist's arsenal. (Curr Probl Cardiol 2021;46:100714.)

Introduction

Coronary angiography is one of the most common procedures done in the United States and in other developed countries. The United States alone accounted for 1,016,000 cardiac catheterizations in 2014.[1] For decades, especially in the United States, the femoral artery has been the most common vascular access site utilized for coronary angiography. Lucien Campeau first introduced the proximal transradial access approach back in 1989 while working at Montreal Heart Institute.[2] In 1992, Kiemeneij performed the first successful proximal transradial percutaneous coronary intervention (PCI). This opened new horizons not only in the field of interventional cardiology but also for other specialties including interventional radiology and interventional neurology.[3]

Conflict of Interest: The authors have no conflicts of interest to disclose.
Curr Probl Cardiol 2021;46:100714
0146-2806/$ – see front matter
https://doi.org/10.1016/j.cpcardiol.2020.100714

This approach is gaining popularity due to the lower rates of access site complications including bleeding. This is especially important during percutaneous coronary interventions due to subsequent anticoagulant use. Furthermore, increased patient comfort and shorted hospital stays have been reported.[4-6]

In 2017, Kiemeneij published a report on distal transradial access (DTRA) in the snuffbox for coronary angiography and intervention.[7] Since published, operators have become more comfortable and skilled with the technique. Using the left distal transradial artery approach has also been found to be particularly useful to engage the left internal mammary artery and in patients unable to supinate their wrist.[8] These techniques have been developed to continue to try to decrease complications, improve patient comfort, and shorten hospital stays.

DTRA

DTRA can be obtained with or without ultrasound guidance. One of the advantages of using ultrasound is the ability to confirm the location of the artery. This can also help avoid injuring a superficial branch of the radial nerve, leading to patient pain and possible long-term damage to the nerve. Ultrasound also allows the operator to determine the radial artery size and identify tortuosity. This can assist the operator in choosing the right sheath and materials for the procedure.[9] It is important to ensure that the distal radial artery is no smaller than the outer diameter of the sheath planned to be used. This helps avoid vessel injury and decreases the risk for radial artery occlusion.[10] This is especially important in women, as it has been demonstrated that women have smaller distal radial arteries than men.[11] When used for the traditional proximal radial access, ultrasound has shown to increase the first pass success rate, decrease the need for repeat arterial punctures, and decrease the time to obtain access. This could translate in a lower rate of vasospasm when using ultrasound for DTRA. However, the use of ultrasound presents another learning curve for the operator unfamiliar with the technique.[12]

Access can be obtained within the anatomical snuffbox or outside of it, in the dorsum of the hand. Local anesthesia can be achieved by administering lidocaine hydrochloride. The artery can be accessed using a 20- or 21-gauge open needle, with a puncture at a 30˚-45˚ angle from lateral to medial, and by using the anterior wall technique. The through-and-through technique should be avoided if possible, in order to prevent contact of the needle with the scaphoid and trapezius periosteum.[7] This can also be minimized by attempted cannulation at an angle of less than 30˚.

If ultrasound is not being used, the needle should be proximally directed to the point of maximum pulse in the snuffbox or just distal to it. After that, a flexible 0.018-0.025 wire can be used to advance a 4-6 Fr hydrophilic sheath. This is followed by the vasodilatory cocktail as would be done when accessing the proximal radial artery.[13]

DTRA Hemostasis

DTRA hemostasis can be achieved manually or by using a compression device. If done manually, a 4 × 4-in sterile gauze is placed at the puncture site while removing the sheath. This is followed by tight wrapping of an elastic bandage or adhesive tape. If deemed necessary, a hemostasis pad can be placed in the puncture site prior to being covered by the gauze. The bandage or tape can be left in place for up to 3 hours if needed to achieve adequate hemostasis.[7]

Alternatively, hemostasis can be achieved using compression devices. The SafeGuard (Merit Medical Systems, South Jordan, UT) is a hemostasis band which is placed over the arterial access site. The band is inflated with up to 3 mL of air with subsequent removal of the sheath and further administration of up to 2 mL of air. The band is left in place for up to 3 hours. The traditional TR band (Terumo Inc., Tokyo, Japan) has also been used for DTRA site hemostasis. If using a traditional TR band, it is advantageous to remove the hard shell that covers the balloon externally. This allows the band to adapt to the surface of the snuffbox or distal to it, which is smaller than at the forearm when accessing the proximal radial artery.[10,14,15]

DTRA Complications

Accessing the distal radial artery is not exempt from the complications that can present by cannulating the vessel in a more proximal segment. This can include local hematoma, nerve injury, major bleeding, and proximal or distal radial artery occlusion. The incidence of radial artery occlusion (RAO) when using the traditional proximal transradial access ranges between 1% and 10%.[16] One of the major advantages of DTRA is the lower rate of RAO, with rates of less than 1% in the forearm and 3% in the distal radial artery. This has been consistent across several studies. The rate of local hematoma, nerve injury, and major bleeding has also been lower than found with proximal transradial access.[7,13,17-20] There has been a report of finger necrosis after an accidental cannulation of the left radial artery instead of the intended vein. However, this occurred after the patient erroneously received medications through the radial

arterial access. A computed tomography angiography later revealed a pseudoaneurysm which led to ischemia and gangrene. This emphasizes the importance of close follow-up by checking collateral and distal blood flow after a radial puncture.[21]

DTRA for Coronary Angiography

Kiemeneij et al reported 70 patients who underwent coronary angiograms and/or PCI in both acute and nonacute settings, who were considered suitable for left distal transradial access (LDTRA) based on the presence of an adequate pulse in the anatomical snuffbox. The success rate was 89% and major adverse events were seen in 3% of the patients.[7] The procedures and subsequent interventions incorporating LDTRA were performed using catheters ranging from 4 to 6 Fr. Among the benefits described were that the patient was able to move his/her wrist more freely after the procedure and increased comfort for the operator who does not have to bend over the patient to reach the left radial artery. Other benefits include faster time to hemostasis and a reduction in the risk of RAO and hand ischemia.[22] DTRA access can also be used after failed attempts to cannulate the ipsilateral proximal radial artery even if there is loss of radial pulse as a result. This may avoid the need for attempted femoral access in these patients.[23,24]

Another study involving 200 patients compared the efficacy and safety of DTRA versus traditional proximal radial approach for coronary angiography. The operators switched to a different access site in 30% of the DTRA cases and in 2% of the traditional proximal radial cases. This study showed that the cannulation time was longer in the DTRA, however, the authors also reported a faster time to achieve hemostasis in the DTRA group. Significant limitations of this study were that the operators had far less experience with DTRA than with the proximal radial approach and that the sample size was small. However, this emphasizes the fact that along with the proximal radial access, DTRA also has an important learning curve.[25]

DTRA in PCI

DTRA has been safely utilized to perform not only diagnostic angiography, but also for coronary interventions. A single-center prospective study conducted in Korea included 200 patients that underwent coronary angiography and PCI via LDTRA by 3 experienced operators. The success rate of arterial puncture was 96%. There were no major bleeding

complications. One patient had a radial artery dissection that resolved spontaneously. The authors concluded that the successful cannulation time improved and stabilized after roughly 150 cases. They also highlighted the importance of a coordinated preparation by the operators as a major factor in achieving acceptable rates of access.[13]

Al-Azizi et al performed 22 coronary angiography procedures, 7 of which proceeded to PCI using the LDTRA. They achieved a 100% success rate without needing to switch to a right femoral or proximal radial access site approach. Similar to other studies, they noted that procedures involving the distal left radial artery are associated with a learning curve. This was thought somewhat secondary to variability of the radial artery's course among different patients. The authors concluded that advantages to this procedure include ergonomic superiority as the patient can rest their hand more easily on their right groin, a greater likelihood of successfully completing the procedure with minimal catheter exchanges and radial artery spasms, and a shorter recovery time than the femoral approach. In addition, this access site is distal to the superficial palmar arch, thus ensuring that blood flow to the hand will not be compromised in the event that a complication arises.[22]

A second study by the same author included 61 selected patients who underwent coronary angiography with or without PCI. The procedures were performed via LDTRA in 99% of the cases. A PCI was performed in 50% of the cases. The authors reported no major access site bleeds, no hematomas and successful hemostasis in all of the cases. In addition, 2 cases underwent repeat revascularization which was successfully done via the LDTRA. The authors emphasize the need for careful patient screening selection. This screening they felt must include a strong palpable pulse and ultrasound assessment of the vessel. Optimal postprocedure follow-up is again essential.[14]

A study from Brazil was conducted by Oliveira et al, including 435 patients that underwent coronary angiograms and/or PCI via right or left DTRA without ultrasound guidance. The procedures included STEMI. The authors reported a 100% success rate of accessing the distal radial artery, with a maximum of 2 cannulation attempts. They reported no major complications.[26]

LDTRA can also be safely utilized to perform PCI in the setting of STEMI. This was demonstrated in a study conducted in Korea. A total of 138 patients presented with STEMI and 80% of them were successfully intervened upon. Primary PCI was done via the DTRA in 128 patients with 80% of these being the left DTRA. There were no major bleeding complications. Three patients developing a local hematoma that resolved without

intervention. The authors concluded that along with being a feasible access route for primary PCI, LDTRA can be used for implantation of ≥2 stents, multivessel PCI, and imaging-guided PCI in patients with STEMI in the majority of the cases. It was also noted that the left subclavian artery is less tortuous than the right subclavian artery in most patients, facilitating vessel navigation, and manipulation of the equipment.[27]

DTRA for Noncoronary Procedures

The DTRA approach is gaining popularity for noncoronary diagnostic and interventional procedures. Other specialties such as interventional radiology and interventional neurology are incorporating this approach to their procedures. DTRA access was documented in a study involving 94 patients who underwent neuroendovascular diagnostic and interventional cerebral procedures in 2 centers. The authors reported that every attempt to do the procedure via the distal radial approach was successful. They also reported a significant decrease in femoral arterial approaches. By beginning a procedure at the distal radial artery, allowing the use of the proximal radial artery if unsuccessful, before resorting to the femoral artery access.[28,29]

LDTRA approach has also been proven to be an effective and feasible technique in perioperative medicine. Maltra et al reported 55 patients who underwent LDTRA cannulation for perioperative management after induction of general anesthesia for major noncardiac surgery. The access was obtained with ultrasound guidance or by the palpation of the distal radial artery at the anatomical snuffbox. There was a high cannulation success rate with no significant difference in the success rate with and without ultrasound guidance.[30] The DTRA technique has also been effectively used for interventional radiology embolization procedures.[31]

Discussion

DTRA is a novel technique that should be in every interventional cardiologist's arsenal. Time and experience have proven that radial access can be safe and efficient if done by experienced operators. Currently, DTRA has been demonstrated to be a safe access site with a possible decreased incidence of complications compared with the proximal transradial approach. However, there are challenges like in every new technique. These may include the need to adapt the equipment originally manufactured for a proximal radial approach such as catheter length. Adapting also the working area may be required whether it is the left or

right side of the patient leading to possibly more radiation exposure. It will also require proper training of the catheterization laboratory and recovery area staff. The learning curve is steep, perhaps steeper than the conventional radial approach. However, current evidence demonstrates that the benefits could be substantial. This should encourage more operators to learn and use this technique when feasible.

Conclusion

DTRA is a technique that can be safely used for acute and nonacute coronary interventions when feasible by an experienced operator, as it can offer better and safer access to some interventions, among other benefits. Limitations certainly include the learning curve required to become an experienced operator. Small scale trials have alluded to a decrease rate of RAO, local hematoma, nerve injury, and major bleeding. Further large-scale studies need to be performed to assess long-term outcomes and complications including a head-to-head comparison with the proximal radial approach.

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