Review
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Distal Radial Access: is There any Clinical Benefit?

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ABSTRACT For decades, the femoral artery has been the most common access for diagnostic and therapeutic endovascular operations. However, over the past 20 years, radial access has been gaining popularity as being safer and more practical with more significant benefits. Recently, the new distal radial access has proven to be equal or perhaps even safer than the vascular access for diagnostic and therapeutic coronary and non-coronary interventions. Today, this access should be in the arsenal of every interventional surgeon.

Key words: distal radial access, radial access, femoral access, coronary angiography, interventional surgery, stenting, acute coronary syndrome, embolization

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AS – anatomical snuffbox
FA – femoral artery
DRA – distal radial access
STEMI – ST-segment elevation myocardial infarction
CAG – coronary angiography
RA – radial artery
PRA – proximal radial access
TRA – transradial access
PCI – percutaneous coronary intervention

INTRODUCTION

Coronary angiography (CAG) is one of the most common procedures in interventional cardiology and endovascular surgery in general. Every year, tens of millions of different interventional procedures are performed worldwide [1]. For many decades, the femoral artery (FA) has been the access of choice for the endovascular surgeon [2]. Lucien Campeau, working at the Montreal Heart Institute, first introduced the proximal radial approach (PRA) back in 1989 [3]. In 1992, Ferdinand Kiemeneij performed the first successful percutaneous coronary intervention

(PCI) through the radial artery (RA). This opened new horizons not only in the field of interventional cardiology, but also in neurointervention, endovascular treatment of vascular, oncological and other pathologies [4].

The transradial approach (TRA) has become popular due to fewer complications, including bleeding. This fact is especially important when performing PCI due to the subsequent use of anticoagulants. In addition, TRA is more comfortable for the patient and reduces the length of his hospital stay, which contributes to the development of outpatient CAG [5–7].

For the first time, A.M. Babunashvili reported on the access through the distal branches of the RA for recanalization of late occlusions of the RA after transradial procedures and early occlusions in 2003 in Amsterdam [8]. The first publications on the use of distal radial access (DRA) as the primary access for diagnostic and therapeutic procedures in comparison with classical ones appeared in 2014 and 2015 [9–11]. Since 2017, the use of DRA in various endovascular procedures has rapidly grown in popularity around the world. The use of the left DRA has been particularly adopted in patients with limited wrist supination when it is necessary to perform angiography of the internal mammary artery [12]. According to the 2019 consensus "Best Practices for the Prevention of Radial Artery Occlusion After Transradial Diagnostic Angiography and Intervention," routine use of DRA may reduce the number of RA occlusions, but large randomized trials are needed to test this theory [13]. In 2017, a multicenter open randomized (1:1) study TENDERA (Comparison between Traditional ENTry point and Distal puncture of RAdial Artery) was organized, No. NCT04211584 at https://clinicaltrials.gov. Interim study data showed fewer local complications of DRA [14].

DISTAL RADIAL ACCESS TECHNIQUE

Performing distal puncture of the RA is possible with or without ultrasonic (US) navigation. One of the advantages of using ultrasound guidance is the ability to confirm the location of the artery and perform an accurate puncture [15]. In addition, the risk of damage to the superficial branch of the radial nerve, which leads to pain in the patient, and possible long-term damage is reduced [9, 16]. Ultrasound examination also allows the operator to determine the size of the proximal and distal parts of the RA, the presence of tortuosity and other anatomical features, which can help the operator select the appropriate level of arterial puncture and the necessary instrumentation [15]. It is important that the diameter of the distal part of the RA is not smaller than the outer diameter of the sheath that is planned to be used to avoid unnecessary trauma to the vessel and reduce the risk of early occlusion of the RA [17]. This is especially important in women, since their distal RA diameter is smaller than in men [18]. Ultrasound navigation improves the success of the first puncture when using traditional TRA, reducing the number of repeated punctures of the artery and reducing the time for access [19]. Also, by analogy, we can say that the use of ultrasound control for DRA will reduce the frequency of arterial spasm [20].

Distal puncture can be performed in the area of the anatomical snuffbox (AS) or the first interdigital space [21]. In the second case, we are talking directly about DRA. The puncture is performed under local anesthesia using a 20 or 21 G needle at an angle of 30–45° on the anterior or lateral wall. If possible, the technique of puncturing both walls should not be performed in order to avoid needle injury to the periosteum of the scaphoid or trapezius [22]. To minimize the possibility of injury, the puncture can be performed at an angle of less than 30°. If ultrasound navigation is not used, the needle should be directed proximally to the point of maximum pulse in the AS or first interdigital space. After obtaining reliable blood flow, a 0.018–0.025″ guidewire is inserted, and then a 4–6 F introducer goes [23]. Some authors provide data on the safe use of 7 F (2.3 mm) sheaths for DRA [24]. The administration of antispasmodics after insertion of the introducer is not a mandatory option and remains at the discretion of the operating surgeon in each specific case [23].

HEMOSTASIS

Hemostasis in DRA is achieved using specialized patented devices or bandaging [21]. Before bandaging, the puncture site is clamped with a sterile napkin when pulling out the introducer; then wrapped tightly with a standard or elastic bandage; the bandage is left in place for an hour to three hours until adequate hemostasis is achieved [22]. The duration of application of a dressing or device depends on a number of factors: the diameter of the introducer, the type of procedure, the amount of heparin administered, the use of antiplatelet agents and (or) other drugs, individual characteristics, etc. [21]. Alternatively, hemostasis can be achieved with a compression device such as SafeGuard Compression (Merit Medical Systems), which is applied to the arterial access site; the strap is inflated to 3.0 ml of air, followed by removal of the introducer and further injection of up to 2.0 ml of air; the device

is left for up to 3.0 hours [22]. TR band (Terumo Inc.) can also be used for DRA hemostasis. When using the TR band, it is better to remove the hard shell that covers the balloon, which will allow it to adapt to the surface of the AS or the first interdigital space, which is smaller than on the forearm [17, 25, 26].

COMPLICATIONS

Access to the distal RA does not completely eliminate complications that are similar to puncture in the proximal segment, such as local hematoma, nerve damage, bleeding of varying severity, and occlusion of the distal or proximal RA. The incidence of RA occlusion when using traditional puncture varies from 1 to 10% [27]. One of the main advantages of DRA is the lower incidence of RA occlusions: less than 1% in the forearm and 3% in the distal part of the RA, which is confirmed by several studies [9, 19, 22, 23]. The incidence of local hematoma, nerve injury, and major bleeding is also lower than with PRA [9, 19, 28–30]. One case report reported digital necrosis after accidental catheterization of the left RA instead of the intended vein. However, this occurred after the patient was mistakenly given medications through the radial arterial approach. Computed tomographic angiography later revealed a false aneurysm, which led to ischemia and gangrene. This highlights the importance of checking the resulting blood flow after puncture and catheterization of the target vessel [31].

DISTAL RADIAL ACCESS FOR CORONARY ANGIOGRAPHY

Kiemeneij et al. reported on 70 patients with acute coronary syndrome or stable angina who underwent coronary angiography and/or PCI who were eligible for left DRA based on the presence of adequate AS pulses. The success rate was 89%, and serious adverse events were observed in 3% of patients [22]. All procedures were performed using 4 to 6 Fr (1.35–2.9 mm) sheaths and catheters. Advantages described include the patient being able to move the wrist more freely after the procedure and maximum operator comfort by not having to bend over the patient to reach the left RA. Other benefits include faster time to hemostasis and reduced risk of RA occlusion and hand ischemia [32]. DRA can also be used after unsuccessful attempts to cannulate the ipsilateral proximal RA even with loss of radial pulsation, thereby avoiding the need for BA puncture [33, 34]. Another study of 200 patients compared the efficacy and safety of DRA versus conventional PRA for coronary angiography. Access conversion when using DRA was 30%, when using PRA – 2%, respectively . This study showed that arterial cannulation time was significantly longer in the DRA group. However, the authors also reported faster achievement of hemostasis in the DRA group. Significant limitations of this study were that the operators had much less experience with the distal portion of the RA than with the proximal portion of the RA, and the small sample size. However, this highlights the fact that along with PRA, DRA also has its own training schedule [35].

DISTAL RADIAL ACCESS DURING PERCUTANEOUS CORONARY INTERVENTIONS

DRA is used safely not only for diagnostic angiography, but also for coronary interventional procedures. A single-center, prospective study conducted in Korea included 200 patients who underwent PCI through the left DRA by three experienced operators. The success rate of puncture of the distal RA was 96%. No serious bleeding was noted among the complications. One patient had RA dissection, which resolved spontaneously. The authors concluded that the learning curve for DRA plateaus after 150 punctures. They also emphasized the importance of coordinated training among surgeons as a major factor in achieving optimal access speeds [23]. Al-Azizi K.M. et al. performed 22 coronary angiographies, 7 of which were continued to PCI using the left DRA. They achieved a 100% cannulation success rate without the need to convert to the right RA, femoral or proximal RA. As with other studies, they noted that there is a learning curve when using DRA. The authors concluded that the advantages of this approach include ergonomics, since the patient can rest when his hand rests more easily on the right groin; higher success rate and complete completion of the procedure with minimal catheter changes and RA spasm and shorter recovery time than after femoral puncture. In addition, this access site is distal to the superficial palmar arch, thus ensuring that blood flow to the arm is not compromised should complications arise [32]. The second study by the same author included 61 patients who underwent coronary angiography or PCI, 99% through the left arm. The authors reported no serious puncture site bleeding or hematomas and successful hemostasis in all cases. In addition, 2 patients underwent repeat revascularization, which was successfully performed through the left DRA. The authors emphasize the need for careful attention to the patient and screening. In their opinion, the examination before the procedure should include palpation at the intended puncture site and ultrasound assessment of the vessel [25].

Oliveira et al. conducted a study from Brazil, including 435 patients who underwent coronary angiography and/or PCI through the right or left DRA without ultrasound guidance. PCI has also been performed in patients with ST- segment elevation myocardial infarction (STEMI). The authors reported 100% successful access to the distal RA, with a maximum of two cannulation attempts. They reported no serious complications [36]. The left DRA can also be safely used to perform PCI for STEMI, as demonstrated in a study from Korea. Primary PCI was performed using the DRA in 128 patients, 80% of them through the left DRA. The authors did not note any serious bleeding. 3 patients developed local hematoma, which resolved without additional interventions. The authors concluded that in addition to using the DRA for primary simple PCI, the left DRA can be used for implantation of 2 stents, PCI in multivessel patients, and image-guided PCI in patients with STEMI in most cases. It has also been noted that the left subclavian artery is less tortuous than the right subclavian artery in most patients, facilitating vessel navigation and instrument manipulation [37, 38].

DISTAL RADIAL ACCESS FOR NON-CORONARY PROCEDURES

DRA is also gaining popularity for non-coronary diagnostic and therapeutic interventional procedures. Neurointerventionalists, vascular surgeons, oncologists, anesthesiologists and other specialists use DRA for their procedures. The use of the distal RA approach was documented in a study of 94 patients undergoing neuroendovascular diagnostic and therapeutic procedures at two centers. The authors reported that every attempt to perform the procedure through the DRA was successful, the number of approaches through the BA was significantly reduced, and they also reported the possibility of using the proximal part of the RA in case of unsuccessful DRA, without immediately resorting to the femoral approach [39, 40]. DRA has also been shown to be effective and feasible in anesthesiology practice. Maltra et al. reported on 55 patients who underwent distal RA cannulation for perioperative management after induction of general anesthesia for major cardiovascular and other surgeries. The access was performed either under ultrasound guidance or only by palpation of the pulsation of the distal part of the RA in the area of the AS. However, the authors did not note a difference in the percentage of puncture success with and without the use of ultrasound navigation [41]. The DRA technique has also been effectively and widely used for embolization procedures in interventional oncology [42].

DISCUSSION

DRA is a modern approach that should be used in the practice of every interventional surgeon. Time and experience have proven that PRA can be safe and effective when performed by experienced operators. Currently, DRA has proven itself to be a safe approach with the potential to reduce the incidence of complications compared to PRA. However, it still has some disadvantages, which is regular when introducing a new technology: the need for a learning curve and adaptation to access, the need to use and currently develop specialized instruments (long introducers and (or) smaller profile catheters, hemostasis devices, etc.). It may also be necessary to adapt the working area, whether it is the patient's left or right hand, which may result in increased radiation exposure. The learning curve for DRA is steep, perhaps steeper than with traditional radial access. However, current literature data demonstrate significant benefits of DRA. This should encourage more procedures to be performed using the DRA technique whenever possible.

CONCLUSION

The distal radial approach can be used safely for acute and non-acute coronary interventions when performed by an experienced operator. Limitations certainly include the learning curve required to become a proficient operator. Small studies indicate a reduction in early and late radial artery occlusions, local hematomas, nerve injuries, and major bleeding. Future large-scale studies are needed to evaluate long-term outcomes and complications, including direct comparison with the proximal radial approach. But now we can talk about the presence of certain clinical benefits, both for the surgeon and for the patient.

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