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Comparison of Distal Transradial Access in Anatomic Snuffbox Versus Transradial Access for Coronary Angiography

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ABSTRACT

Background: To compare distal transradial access (dTRA) in the anatomic snuffbox and conventional transradial access (cTRA) for coronary angiography.

Methods: Eighty cases that underwent coronary angiography were selected at The 903 Hospital of PLA in China from April 2017 to March 2018. Patients in the dTRA group underwent distal transradial access, and patients in the cTRA group received conventional transradial access. Puncture success rate, fluoroscopy time, and hemostasis time were determined.

Results: The puncture success ratio was 85% in the dTRA group and 100% in the cTRA group ($P < .05$). The fluoroscopy time was 36 minutes and 19 min minutes in the dTRA group and cTRA group ($P < .05$), respectively. The compression hemostasis time after operation was 120 minutes and 240 minutes in the dTRA group and cTRA group ($P < .05$), respectively. The complication rate in the cTRA group was 7.5%, while there was no complication in the dTRA group. In addition, there also was no significant difference between the two groups in the rate of complications (cTRA = 7.5%, dTRA = 0.0%, $P > .05$).

Conclusion: Distal transradial access in the anatomical snuffbox for coronary angiogram is a potential alternative to conventional radial arterial access.

INTRODUCTION

Radial access has shown to be superior to femoral access in all clinical scenarios, and therefore, has been listed as the preferred access in the 2015 European Society of Cardiology guidelines (Class I indication) [Bueno 2015]. Compared with the transfemoral approach, the major advantages of coronary intervention via radial approach are safety and patient comfort as well as reduction of bleeding complications [Jolly 2011; Valgimigli 2015]. At present, the transradial approach is considered the default technique for coronary intervention. However, the transradial approach still has its limitations. For example, the spasm of radial artery would hamper the advance of the catheters, the repeated coronary intervention via radial approach may lead to complication of radial artery occlusion, which has been described in 1-10% of all patients [Kotowycz 2012; Stella 1997; Nagai 1999], and improper radial artery hemostasis may induce the complication of forearm hemorrhage.

Recently, it has been reported that coronary intervention could be performed by the distal transradial access puncture in the anatomical snuff box [Toledo 2018]. One of the best advantages of dTRA is to avoid the complication of radial artery occlusion. In this study, we aimed to describe our experience regarding feasibility, safety, and complications with this new access distal transradial compared with conventional transradial access for coronary angiogram.

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METHODS

Patients

A total of 80 patients diagnosed with coronary heart disease who underwent coronary angiogram were included in this study from the Department of Cardiology of The 903 Hospital of PLA in China, from April 2017 to March 2018. The inclusion criteria were all patients who were willing to receive coronary angiography, but not PCI. The exclusion

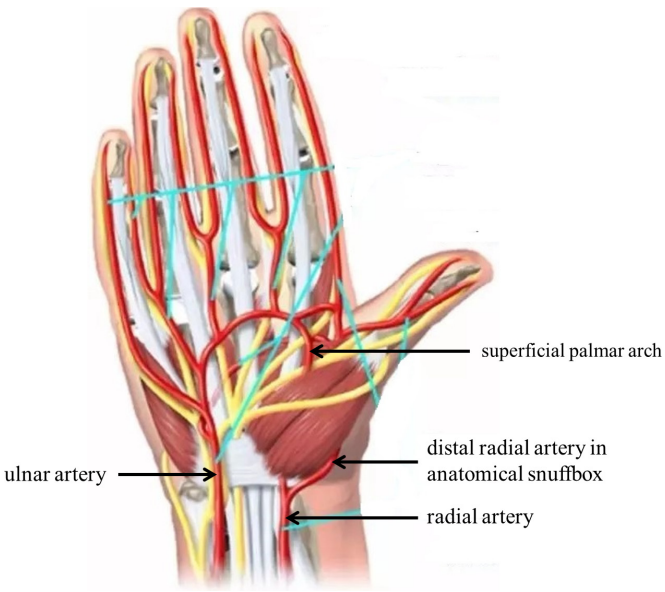

Figure 1. Blood vessels of the distal forearm and hand.

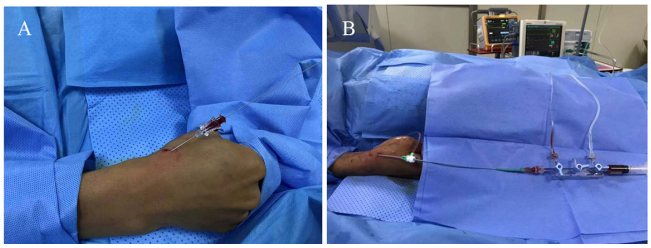

Figure 2. Percutaneous coronary angiography via dTRA. A, success of puncture; B, insertion of sheath and catheter.

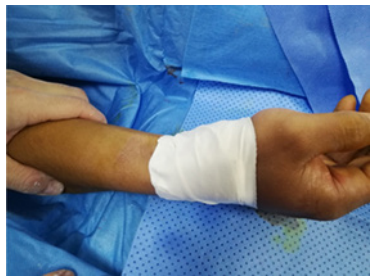

Figure 3. Hemostasis with a small gauze plug after operation.

criteria were women weighing less than 50kg, and patients who wanted to receive PCI at the same time if the lesions were found after coronary angiography. All patients were divided into the dTRA group and cTRA group, and each group had 40 patients. Patients in the dTRA group underwent distal transradial access, and patients in cTRA group underwent conventional transradial access.

Procedures

Blood vessels of the distal forearm and hand are shown in Figure 1. Radial occlusion was checked using ultrasonic angiography. The dTRA and cTRA were randomly performed. Patients in the dTRA group were given routine iodophor sterilization on their right forearms, wrists, and hands. Sublingual nitroglycerin was applied before puncture for all patients. The patient's right hand was kept on the right side of the body, and the thumb was bent with the other four fingers to make the radial socket more prominent. One operator with rich experience of radial artery puncture is located on the right side of the patient to prepare for the distal right radial artery or routine puncture. After subcutaneous injection of 3-5 cc xylocaine to fill the radial fossa, the distal radial artery of the anatomic snuffbox is punctured, preferably with a 21-gauge (G) open needle (Cordis Corporation, USA), under an angle of 30-45 degrees from lateral to medial. The needle is directed to the point of strongest pulse, proximal in the anatomical snuffbox (Figure 2A). Successful puncture was followed by an insertion of 0.018-inch straight guide wire with a soft, flexible proximal part and a rigid distal part. Then, a 5 or 6 French radial hydrophilic sheath was introduced into the distal radial artery and a cocktail of 2500 units of unfractionated heparin, 100 mcg of nitrate and 1ml (2.5 mg) of verapamil was administered to all patients to prevent arterial spasm. Then 5 French catheters (TIG, Terumo Corporation) were used for the coronary angiography via a 5 or 6 French radial hydrophilic sheath (Figure 2B).

Puncture time was determined from local anesthesia until cannulation of the vessel. The fluoroscopy time was obtained electronically from the "software" of each hemodynamic device. At the end of the procedure, hemostasis was applied through a compressive dressing with a small gauze plug (Figure 3).

Patients in the cTRA group underwent coronary angiography via conventional right radial artery, and the operation steps were same as the dTRA group. The same cocktail was used in both accesses. Coronary angiography was performed in both accesses without percutaneous transluminal coronary intervention. Conventional radial artery puncture and femoral artery puncture were performed where distal TRCA failed.

Statistical analysis: SPSS16.0 statistical software (SPSS Inc, Chicago, IL) was utilized for all statistical analysis. ANOVA was used for comparison between multiple groups, following Tukey's multiple comparison tests. The level of statistical significance was $P < .05$.

RESULTS

Demographic features are shown in Table 1. There were 23 males and 17 females in the dTRA group with a mean age of 54.3 ± 14.5 years and a weight of 68.5 ± 12.6 kg. There were 25 males and 15 females in the cTRA group, with a mean age of 56.4 ± 13.7 years, weighing 70.9 ± 11.4 kg. In addition, there were six diabetic patients and five cases of peripheral vascular disease in the dTRA group, and seven diabetic patients and six cases of peripheral vascular disease in the cTRA group. No chronic renal insufficiency was found in either of the dTRA and cTRA groups. There were no statistically significant differences in terms of age, gender, weight, diabetes, and peripheral vascular disease between the groups.

The results of fluoroscopy time, hemostasis time by compression, puncture success rate, and complications between the two groups are shown in Table 2. Of the 40 patients in the dTRA group, puncture was failed in six cases (15%), including three cases failed to puncture distal radial artery, two failed to insert 5 or 6 French radial hydrophilic sheath after successful puncture in distal radial artery, and one failed to insert TAG due to spasm of the distal radial artery, while in the cTRA group, the success rate of puncture was 100% ($P < .05$).

There was no significant difference in the incidence rate of complications between the two groups (cTRA = 3/40 [7.5%], dTRA = 0/40 [0.0%], %, $P > .05$). The complication rate in cTRA included one case of radial artery occlusion after the procedure, one case of local hematoma, and one case of tension blisters. The fluoroscopy time was 36 minutes and 19 minutes in the dTRA group and cTRA group, respectively ($P < .05$). The compression hemostasis time after operation was 120 minutes and 240 minutes in the dTRA group and cTRA group, respectively ($P < .05$).

Twenty-five patients in the dTRA group were discharged on the same day after their coronary angiogram. Most patients in the cTRA group were discharged on the second

Table 1. Demographic characteristics of study population

Demographic parameters	dTRA group (N = 40)	cTRA group (N = 40)
Age (Mean±SD)	54.3 ± 14.5	56.4 ± 13.7
Weight (kg, Mean±SD)	68.5 ± 12.6	70.9 ± 11.4
Male, n (%)	23 (57.5%)	25 (62.5%)
Female, n (%)	17 (42.5%)	15 (37.5%)
Diabetes, n (%)	6 (15.0%)	7 (17.5%)
Chronic renal insufficiency, n (%)	0	0
Peripheral vascular diseases, n (%)	5 (12.5%)	6 (15.0%)

Table 2. Fluoroscopy time, hemostasis time by compression, puncture success rate and complications between the two groups

	dTRA group (N = 40)	cTRA group (N = 40)	*P*
Puncture success rate (%)	85.0	100.0	<.05
Complications (%)	0	7.5	>.05
Fluoroscopy time (min)	36	19	<.05
Hemostasis time (min)	120	240	<.05
Time to remove the bandages (min)	180	360	<.05

day post-coronary angiogram. The mean hospital stay was two days and 3.5 days for the patients undergoing coronary angiogram with dTRA and cTRA, respectively. Compared with cTRA, dTRA has a shorter hospital stay.

DISCUSSION

In the present study, puncture success ratio was lower in the dTRA group compared with that in the cTRA group (85% versus 100%). Fluoroscopy time was 36 minutes and 19 minutes in the dTRA group and cTRA group, respectively. Patients in the dTRA group had shorter hemostasis time after operation compared with the cTRA group (120 minutes vs. 240 minutes). There were no complications in the dTRA group.

Currently, most percutaneous coronary intervention can be performed safely and comfortably via transradial approach [Agostoni 2004]. The occlusion of the radial artery is the most common operative complication of transradial approach intervention, especially for those who experienced many times of intervention operations via transradial approach [Rao 2005]. Unfortunately, occlusion of the radial artery can lead to functional disability of the hand [Zankl 2010].

Kiemeneij et al demonstrated the feasibility of the approach via the distal radial artery located at the anatomical snuffbox [Kiemeneij 2017]. In addition, Amin R et al [Amin 2018] found that distal transradial access in the anatomical snuffbox for coronary angiogram and intervention was a safe and feasible alternative for both patients and operators. Compared with the cTRA, the procedure of coronary intervention via dTRA has fewer complications. Our study also demonstrated that 2.5% patients undergoing cTRA developed occlusion of radial artery, but no one in the dTRA group had this complication. The distal radial artery passes through anatomical snuffbox in a deep manner. Distally, it continues as the deep palmar branch of the radial artery, forming the deep palmar arch of the hand. The distinctive feature of this arterial segment is that it is located distally to the superficial palmar branch of radial artery, which joins the superficial palmar arch. Even if the distal radial artery of the anatomic snuffbox occluded, tissue ischemia can be prevented by maintaining antegrade blood flow through the superficial palmar arch and the communicating collaterals.

There are several other complications via cTRA, such as radial artery spasm, hematoma, and iatrogenic pseudoaneurysms. Local hematoma is another common complication caused by cTRA. However, hematoma complication was rare in dTRA, and hemostasis by compression is easy because the distal radial artery is thin and superficial. Shorter (two to three hours) hemostasis time was another advantage of distal radial access. In China, the general hospitalization period is at least three to four days. In this study, 62.5% patients in the dTRA group were discharged on the same day after their coronary angiogram. The mean hospital stay was two and 3.5 days for the patients undergoing coronary angiogram with dTRA and cTRA, respectively, indicating that the length of hospital stay significantly was shorter in dTRA group.

In clinical practice, the operator needs to bend over the patient to reach for the left radial artery, which causes inconvenience to the operator and extends the fluoroscopy time. Most operators prefer the right radial artery because they operate on the right side of the patient. Thus, right-side accesses were selected in this study. During cTRA vascular access, the right hand was kept in a supine position and kept dorsiflexed in a supported state, however, during dTRA, the patient's hand was kept in a semi-prone position without any support, thereby avoiding the possibility of discomfort. Six French hydrophilic radial artery sheaths were introduced in all patients after puncture. There were no resistances to advance the wire and 6 French catheters through the sheath in both two accesses, indicating that the angle of the sheath is coaxial with the radial artery.

Moreover, the intervention via cTRA in some patients with right radial artery spasm or occlusion could not successfully be completed. Therefore, left dTRA may be a good option. The left arm can be placed on the left side of the patient, and the left hand is bent toward the patient's right groin. The operator works as usual from the right side of the patient and does not need to bend over the patient to reach for the left radial artery, especially when the patient is obese and the operator not tall enough.

The limitation of dTRA is the lower success rate of puncture than the cTRA. The thinner distal radial artery is the main cause of puncture failure. Advice is summarized below to improve the success rate of puncture. First, the Seldinger technique for puncturing often leads to puncture failure. In

addition, it is difficult to penetrate the vessel wall for trocar because the dTRA is attached to the scaphoid bones. Therefore, a 21-gauge (G) open needle is recommended to be applied to puncture the distal radial artery. Second, the dTRA was not suitable for low-weight female patients. The dTRA of low-weight women were too small to puncture, and even if the puncture is successful, the 5F sheath cannot be inserted. Moreover, it is recommended that all patients with systolic blood pressure > 100mmhg be given appropriate local anesthesia at the exact position of wrists and sublingual nitroglycerin before puncture to improve the success of puncture.

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CONCLUSION

Distal radial artery access has certain practical application value in clinic. Given the failure rate, there's a learning curve to master the technology of puncturing the distal radial artery.

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