Clinical Trial/Experimental Study

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Distal radial artery access in the anatomical snuffbox for coronary angiography and intervention

A single center experience

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Abstract

Background: To explore the feasibility and safety of coronary angiography (CAG) and percutaneous coronary intervention (PCI) via the distal radial artery in the anatomical snuffbox.

Methods: Ninety two patients who underwent CAG or PCI through distal radial artery access at The Second Affiliated Hospital of Zhejiang Chinese Medical University from September 2017 to March 2018 were included in our study. We collected baseline characteristics, number, and duration of arterial punctures, procedural success rate, postoperative compression time, the numerical rating scale (NRS) scores at 3 hours after procedure, complications, hospitalization duration.

Results: The mean age was 69±11years (44–92 years), and there were 57 males (62.0%). The diameter of the right distal radial artery and the more proximal right radial artery were 0.171±0.05 cm, 0.213±0.06 cm, respectively. On average, the number of puncture attempts was 1.52±0.81, access time was 2.3±1.78 minutes (0.33 – 8.72 minutes), access success was 95.7%, the postoperative compression time was 3.41±0.76 hours (2–6 hours), the NRS scores at 3 hours was 1.53±0.72 (1–4), and the mean hospitalization duration was 7.13±4.02 days. Four patients underwent left distal radial artery access and 88 patients underwent right distal radial artery access. There were 3 local hematomas after procedure and 2 patients had vasospasm. There were no cases of major bleeding, arteriovenous fistula, radial artery occlusion, or hand numbness.

Conclusion: Cardiac catheterization through the distal radial artery in the snuffbox is safe and feasible. The right distal radial artery access can be routinely carried out.

Abbreviations: CAG = coronary angiography, CHD = coronary heart disease, NRS = numerical rating scale, PCI = percutaneous coronary intervention, RAO = radial artery occlusion.

Keywords: anatomical snuffbox, coronary angiography, distal radial artery, percutaneous coronary intervention, radial artery

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1. Introduction

Coronary heart disease (CHD) is the most common cause of death among adults. Coronary atherosclerosis causes coronary stenosis or occlusion, leading to myocardial ischemia, or necrosis. Coronary Angiography (CAG) and percutaneous coronary intervention (PCI) are important tools for the diagnosis and treatment of CHD.[1] The access routes for CAG and PCI include the femoral artery, radial artery, brachial artery access, and ulnar artery. With the improvement in technology and equipment, transradial coronary intervention has become the preferred approach for coronary interventional treatment in the world.[2,3] In 2017, Kiemeneij[4] reported that radial artery cannulation in the anatomical snuffbox is safe and feasible. This new approach can overcome some drawbacks of standard radial artery cannulation in several aspects. The anatomical snuffbox is a hollow space located on the dorsal side of the hand and can be clearly observed after the thumb is fully extended. The ulnar border of the anatomical snuffbox is the tendon of the extensor pollicis longus muscle. The radial border includes the tendons of abductor pollicis longus and extensor pollicis brevis muscles. The base of the anatomical snuffbox is the scaphoid and trapezium bones. The distal part of the radial artery passes through the anatomical snuffbox.[5] The purpose of this study is to evaluate the safety and feasibility of the radial artery access in the anatomical snuffbox, in particular for the right distal radial artery.

2. Methods

This was a retrospective, single-center, observational study. Ethical approval was obtained from the hospital committee (2018-KL-003-01). Patients who underwent CAG or PCI through the distal radial artery access at The Second Affiliated Hospital of Zhejiang Chinese Medical University from September 2017 to March 2018 were selected. Informed consent was signed for each patient.

3. Patients' selection

Our study screened 92 patients. The most important inclusion criterion was the presence of a pulse in the snuffbox. All patients underwent Allen test and radial artery ultrasound before procedure in order to assess vessel size and patency. The preprocedural exclusion criteria were:

(1) Absence of pulse
(2) Ultrasound indication of arterial occlusion or severe calcification
(3) Severe forearm artery malformation
(4) Patients with severe liver and renal failure, or abnormal coagulation function
(5) Shock
(6) History of previous coronary artery bypass grafting and radial artery use.

3.1. Technique

The patient was positioned supine on the angiography table. The patient's left arm was naturally placed over the patient's belly and the hand was positioned over the right groin as described by Kiemeneij,[4] who used left distal radial artery access (Fig. 1A). In case of right radial access, the right upper arm was positioned comfortable next to in a side-board (Fig. 1B). Compared to other studies, we did not ask the patient to grasp his thumb under the other 4 fingers in order to bring the radial artery on the surface of the radial fossa. The operator who had extensive experience (more than 100 radial procedures performed) stood on the right side of the patient and reconfirmed the point of the puncture (Fig. 1C). After subcutaneous injection of 1 mL lidocaine through a 5 ml needle, Seldinger's technique puncture was performed in the anatomical snuffbox. We do not recommend a through-and-through puncture because the pain caused by the needle tip touching the periosteum of the scaphoid or trapezium bones. The radial artery puncture was performed with a 20 G micropuncture needle and a 0.025" wire. Sheath size was determined by the vascular diameter (Fig. 1D). A spasmolytic cocktail consisting of 200 mcg of nitroglycerine and weight-based heparin was given intraarterially after successful insertion of the sheath.

3.2. Vascular hemostasis

It is convenient to use elastic bandage for hemostasis. A small pile of gauze was placed over the puncture site and rolled up tightly with a semi-elastic bandage, without including the thumb (Fig. 1E, 1F).

3.3. Data collection

We collected the following data:

(1) Baseline characteristics of the patients (age, sex, coronary risk factors)
(2) Number of puncture attempts
(3) Access time
(4) Total procedure time
(5) The numerical rating scale (NRS) scores at 3 hours after procedure. NRS scores is an 11-point numeric rating scale (0–10 numeric rating scales; higher scores = greater pain; 0: painless; 1–3: mild pain; 4–6: moderate pain; 7 – 10 severe pain)

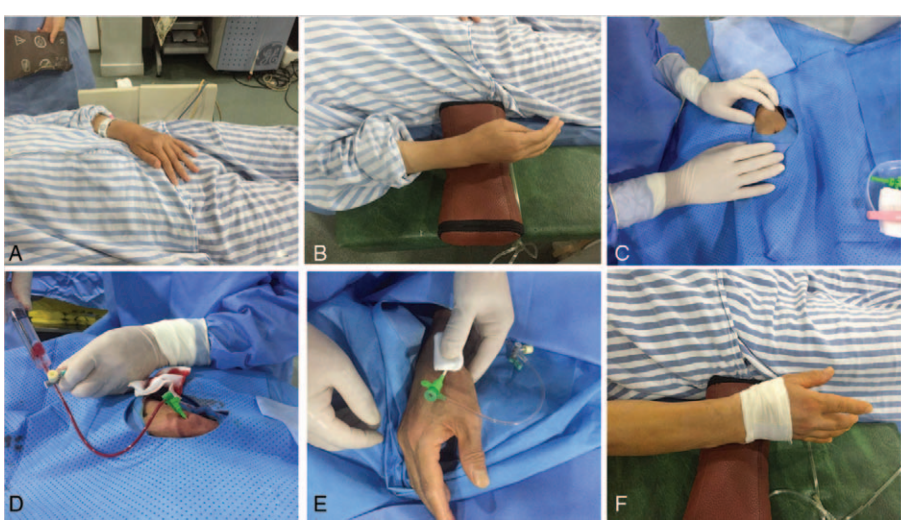

Figure 1. A: The patient's left arm was naturally placed over the patient's abdome and the hand was positioned over the right groin, for left distal radial artery access. B: The right upper arm was positioned comfortably next to the side on a side- board, for right distal radial artery path. C: Reconfirming the point of the puncture. D: A 6F sheath inserted into the right distal radial artery. E and F: Elastic bandages used for hemostasis for several h, without including the thumb.

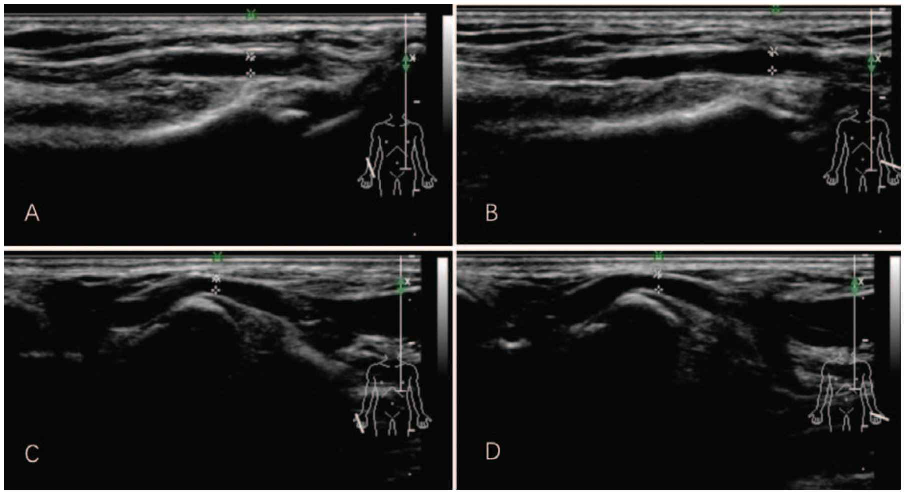

Figure 2. A and B: Ultrasound measurement the diameter of the radial artery trunk 2–3 cm proximal of the styloid process. Ultrasound measurement of the distance from the standard radial artery to the surface of the skin. C and D: Ultrasound measurement of the diameter of the distal radial artery in the anatomical snuffbox. Ultrasound measurement of the distance from the distal radial artery to the surface of the skin.

(6) Postoperative compression time
(7) Hospitalization time
(8) Postoperative complications (major and minor bleeding, hematomas, vasospasm, arteriovenous fistula, radial artery occlusion (RAO), arm movement disability)
(9) Ultrasound (Philips iE33 ultrasound machine; Philips L11-3 ultrasound Probe) measurement of the diameter of the artery both of distal radial artery in the anatomical snuffbox and radial artery in the proximal 2–3 cm of the styloid. Ultrasound measurement of the distance from the blood vessel to the surface of the skin (Fig. 2).

3.4. Statistical analysis

All statistical analyzes were performed with SPSS 20.0 statistical software. The measurement data were all expressed as means ± standard deviation.

4. Results

From September 2017 to March 2018, a total of 92 patients were included in our study. Demographic characteristics are shown in Table 1. The mean age of the patients (57 males [62.0%]) was 69 ± 11years. Hypertension, diabetes, dyslipidemia and smoking were present in 67.4%, 32.6%, 57.6% and 32.6%, respectively.

The diameter of the right radial distal artery was 0.171 ± 0.05 cm and the diameter of the right radial artery more proximally was 0.213 ± 0.06 cm. The results of specific preoperative ultrasound measurements are shown in Table 2.

Procedural characteristics are summarized in Table 3. According to the preferences of the interventional physicians, 4 cases underwent left distal transradial access and was successful in all patients. Meanwhile, 88 cases underwent right distal transradial access with 4 failures, requiring conventional right radial artery approach. In 1 patient the puncture failed because of vasospasm, while in 3 patients there were >5 attempts to cannulate the artery. All patients had 6 Fr sheaths (n = 92; 100%). On average, the number of puncture attempts was 1.52 ± 0.81. Overall mean artery access time was 2.3 ± 1. 8 minutes, ranging from 0.3 to

Table 1

Demographic characteristics of study population.

Demographic features	Mean ± SD (range)/ N (%)
Age, yr	69.14 ± 11.18 (44–92)
Female	35 (38.0%)
Male	57 (62.0%)
LVEF	63.68 ± 7.76 (40–81)
Diagnosis	
ACS	45 (48.9%)
CAD	34 (37.0%)
Others	13 (14.1%)
Comorbidities	
Hypertension	62 (67.4%)
DM	30 (32.6%)
Dyslipidemia	53 (57.6%)
Smoking	30 (32.6%)

ACS = acute coronary syndrome, CAD = chronic coronary artery disease, DM = diabetes mellitus, LVEF = left ventricle ejection fraction, PLT = platelet count, SD = standard deviation, PT = procedural time.

Table 2

Preoperative ultrasound examination result.

parameters	Mean ± SD (range)
Radial artery diameter, cm	
Left	0.211 ± 0.06 (0.11–0.34)
Right	0.213 ± 0.06 (0.10–0.38)
Radial distal artery diameter, cm	
Left	0.170 ± 0.05 (0.10–0.28)
Right	0.171 ± 0.05 (0.10–0.29)
Distance from the blood vessel to the surface of the skin, cm	
Left Radial artery	0.359 ± 0.11 (0.17–0.76)
Left radial distal artery	0.541 ± 0.27 (0.25–1.33)
Right Radial artery	0.363 ± 0.12 (0.16–0.79)
Right radial distal artery	0.535 ± 0.29 (0.23–1.60)

Radial artery diameter = radial artery in the proximal 2–3 cm of the styloid, radial distal artery diameter = distal radial artery in the anatomical snuffbox.

Table 3

Per procedural characteristics of patients undergoing left and right distal radial artery access.

parameters	Mean ± SD/ N (%)
CAG only	53 (57.6%)
CAG and PCI	39 (42.4%)
Left distal transradial access	4
Success of left puncture	4 (100%)
Right distal transradial access	88
Success of right puncture	84 (95.45%)
Number of puncture attempts	1.52 ± 0.81 (1–5)
Artery puncture time, min	2.3 ± 1.77 (0.33–8.72)
NRS scores at 3 h after operation	1.53 ± 0.72 (1–4)
Postoperative compression time, h	3.41 ± 0.76 (2–6)
Postoperative complications	
Major bleeding	0
Hematomas	3
Vasospasm	2
Arteriovenous fistula	0
Radial artery occlusion	0
Arm movement disability	0
Hospitalization length, d	7.13 ± 4.02 (1–4)
X-ray exposure time	
CAG only, min	3.23 ± 1.66
CAG and PCI, min	16.46 ± 7.42

CAG = coronary angiography, NRS = numerical rating scale (pain described during left and right distal transradial coronary angiography), PCI = percutaneous coronary intervention, RAO = radial artery occlusion, SD = standard deviation.

8.7 minutes. The NRS scores at 3 hours after operation was 1.53 ± 0.72. The postoperative compression time was 3.4 ± 0.8 hours. The mean hospitalization duration was 7.1 ± 4.0 days. The mean X-ray exposure time was 3.23 ± 1.66 minutes in the CAG group. No patient complained of significant discomfort. Three patients (3.3%) had local hematoma after procedure, probably due to multiple punctures. After pressure dressing, the hematoma improved, and did not affect hand activity. Two patients (2.1%) had vasospasm. No major bleeding, arteriovenous fistula, RAO or other complications were noted. No patient complained of dysfunction of the hand or arm.

5. Discussion

The radial artery and femoral artery access are commonly used approaches for CAG and PCI. In recent years, transradial access has rapidly become more prevalent.[6] A large number of studies have confirmed that transradial access can eliminate some of thedeficiencies of femoral access. The patients with transradial access feel more comfortable, have less local pain and complications; radial access reduces mortality and major adverse cardiac events in STEMI patients.[7–10] Anatomically, the radial artery is more superficial than the femoral artery, and can be easily compressed. The end of the radial artery anastomoses with the deep palmar branch of the ulnar artery to form a deep palmar arch with abundant collateral circulation. The incidence of hand ischemia, necrosis or dysfunction after transradial artery puncture is low.[11] However, the standard radial artery approach has its disadvantages. The most common complication is RAO. Multiple coronary interventions through radial artery puncture can also increase the incidence of arterial occlusion.[12]

After Kiemeneij[4] firstly reported left distal transradial access in the anatomical snuffbox for interventional therapy, several studies[13–15] have found that coronary artery interventional therapy through this access is feasible. The new access has become a new hot spot. Left distal radial artery access provides a new approach for coronary intervention, especially in patients with right RAO or with used right radial artery for bypass grafting. This new approach can improve the comfort of patients and operators by allowing a more comfortable posture during the procedure and shorter postoperative hemostasis time. In addition, there may be a reduced risk of RAO.

Our study found that coronary intervention through the distal radial artery in the snuffbox is safe and feasible, especially in the right distal radial artery. The NRS score is low and the hemostasis time is short, using minimal resources. No major complications were reported, and the patients tolerated it well. The main advantages of the distal radial artery access:

(1) Reduce postoperative arterial compression time and increase patient's comfort.
(2) Compared with conventional radial artery access, it can increase the surgeon's comfort.
(3) For patients requiring coronary artery bypass grafting, the distal radial artery access can reduce the probability of radial artery trunk injury.

During the new approach, whether left or right, the arm placement during procedure is more comfortable than that of conventional radial artery access. For obese patients and patients with shoulder or elbow joint diseases, the arm placement requirements during procedure can be better achieved and the comfort of patients can be improved. Although the sample size of this study was small, it was consistent with other studies relative to patient comfort.

From the anatomical point of view, the radial artery in the snuffbox is located at the distal end of the radial artery. The diameter of the puncture site is obviously smaller, access is more difficult, and the learning curve is longer. In this study, the success rate of distal radial artery access was as high as 95%, the number of punctures was 1–5 times, minimizing the risk of peripheral nerve injury, arteriovenous fistula and thrombosis.[5] Radial artery, cephalic vein and superficial branch of radial nerve pass through the anatomical snuffbox.[16] Radial nerve injury is a common peripheral nerve injury, which can cause abnormal sensation in the back of the hand. Robson et al found a close relationship between the radial nerve and the radial artery.[17] Although there were no neurological problems in this study, we still need to further clarify the relationship between the radial artery and the distribution of nerves in the snuffbox. In addition, preoperative ultrasound can be used to improve the success rate of puncture and avoid distal RAO. With the continuous accumulation of puncture experience, the number and time of punctures will be improved.

In previous studies,[18] in 86.1% of Chinese patients the diameter of the radial artery was larger than that of the 6-Fr sheath (2.52 mm). At present, most heart centers choose the 6F sheath for coronary intervention through radial artery, and most procedures can be performed through 6F sheath. In this study, we chose 6F sheath in all patients and successfully completed the procedures. 7F sheath is the preferred guiding catheter for the management of high complex lesions because of its stronger support and instrument trafficability.[19] Because the size of the distal radial artery is smaller (usually less than 2 mm), the femoral artery access and standard radial artery access are still recommended for patients requiring 7F sheath operation.

In CABG, the radial artery has higher patency rate than the great saphenous vein, which is an important artery conduit besides the internal mammary artery.[20] Studies have found that catheterized radial arteries have abnormal morphology and function, and it is recommended that they should not be used for coronary artery bypass grafting. Yet, the radial artery is a desirable conduit for bypass because of its higher patency rate. The distance from distal radial artery puncture site to standard radial artery puncture site is about 5 cm. The distal radial artery access can reduce the probability of radial artery trunk injury, which may bring certain benefits and needs further research and confirmation.[21,22]

6. Limitations

This study is a single-center study. A multi-center large sample is needed to compare radial artery access in the snuffbox with standard radial artery access, with respect to access success, procedural success, complications, postoperative compression time, use of contrast agent, X-ray exposure time, and so on. The need for ultrasound testing before the procedure adds time and cost to this access approach.

7. Conclusions

Cardiac catheterization through the distal radial artery is safe and feasible. The right distal radial artery access can be routinely carried out.

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