Characteristics of distal radial artery diameter and its related factors and predictors

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Abstract

Objective: The distal transradial access (dTRA) is a new access for Coronary angiography (CAG) and percutaneous Coronary intervention (PCI). The distal radial artery diameter is smaller than the radial artery diameter. At present, there are very few studies about the diameter of the distal radial artery. **Methods**: This is a cross-sectional single-center study. A total of 106 hospitalized patients were included. The distal radial artery diameters of the left hand of all patients were measured. Clinical and ultrasound data were collected. **Results**: The mean of the distal radial artery diameter of all patients was 2.0586 ± 0.33 mm. According to the mean, the patients were divided into two groups——diameter [?] 2.0586 mm group and diameter < 2.0586 mm group. By comparing the two groups, the related factors and independent predictors of the distal radial artery diameter [?] 2.0586 mm were obtained. Male gender, height [?] 160 cm, weight [?] 63 kg, body mass index (BMI) [?] 24 kg/m2, and body surface area (BSA) [?] 1.6573 m2 were related factors. Male gender and BMI [?] 24 kg/m2 were independent predictors. **Conclusions**: Male gender and BMI [?] 24 kg/m2 patients may have a larger distal radial artery diameter.

1 Introduction

Coronary heart disease (CHD) is one of the most common cardiovascular diseases in clinical practice. Coronary angiography (CAG) and percutaneous coronary intervention (PCI) are the main diagnostic and therapeutic methods for CHD. Transfemoral access is the earliest access site proposed for both CAG and PCI [(1)]. Transfemoral access is easily accessible even in hypotensive patients but, on the other hand, it may lead to a high incidence of complications (e.g., arteriovenous fistula and pseudoaneurysm) and the postoperative immobilization time is long. Therefore, the application of transradial access (TRA) for CAG and PCI was first reported in 1993 by Kiemeneij et al. [(2)]. To date, the TRA has become the preferred method for CAG and PCI [(3)]. However, the TRA-associated complications are noteworthy, such as radial artery occlusion (RAO). Although some preventive strategies have been recently adopted for RAO, the incidence of RAO is still as high as 3.7%[(4)]. Therefore, Kiemeneij et al. [(5)]reported the use of dTRA for CAG and PCI for the first time in 2017.

To date, randomized controlled clinical trials and meta-analyses have shown that CAG and PCI using dTRA can significantly reduce the incidence of RAO [(6-8)]. Will the dTRA become the preferred method for CAG and PCI in the future? The puncture success rate of the dTRA is lower than that of the TRA [(6, 7)]. The diameter of the distal radial artery is smaller than that of the radial artery, which is one of the most important

reasons affecting the puncture success rate. At present, there are very few studies about the diameter of the distal radial artery.

Methods

2.1 Study design

This study was a cross-sectional single-center study. The study was conducted in Guangdong Provincial People's Hospital Ganzhou Hospital, Ganzhou Municipal Hospital, China, between November 2021 and January 2022; and was approved by the hospital Scientific Board and Ethics Committee. All participants provided written informed consent.

2.2 Study population

A total of 106 patients were screened according to the inclusion and exclusion criteria.

The inclusion criteria were as follows: 1. Patients who were admitted to the Cardiology Department; 2. Patients who aged 30-90 years old. The exclusion criteria were as follows: 1. Patients who used dTRA or TRA; 2. Patients with upper extremity arteriovenous fistulas; 3. Patients who underwent hand and upper extremity surgery; 4.Patients with a history of wrist fractures.

2.3 Ultrasound measurement

The patient lied in bed, the upper limbs were placed on both sides of the body, the back of the hand was perpendicular to the bed surface, and the left hand held the bandage. The sonographer palpated and marked the radial artery at the 2 cm proximal to the transverse crease of the wrist. The sonographer palpated and marked the distal radial artery at the anatomical snuffbox. The same sonographer used the same ultrasound machine and the same ultrasound probe to measure the distal radial artery and the radial artery of the left hand of all patients (Figure 1). The ultrasound machine was a PHILIPS CX50 (Royal Philips, Amsterdam, the Netherlands); the ultrasound probe was an L12-3 broadband linear array probe (probe frequency, 3-12 MHZ).

2.4 Data collection

The same researcher collected clinical and ultrasound data of all patients, including gender, age, height, weight, body mass index (BMI), body surface area (BSA), hypertension, diabetes, CHD, atrial fibrillation (AF), history of cerebral infarction, peripheral arterial disease, smoking history, pulse rate on admission, systolic blood pressure (SBP) on admission, diastolic blood pressure (DBP) on admission, fasting blood glucose (FBG), total cholesterol (TC), triglyceride (TG), diameter of the radial artery, depth of the radial artery, PSV(peak systolic velocity) in the radial artery, diameter of the distal radial artery,, depth of the distal radial artery, PSV in the distal radial artery. BSA was calculated using the Mosteller formula[(9)]. All data were entered into the database by the same researcher. Another researcher checked all the data. In case of any questionable data, they were re-checked by another researcher.

3 Statistical Analysis

Based on previously published data [(10, 11)], there are about five factors——gender, height, weight, BMI, BSA——related to the diameter of the distal radial artery. We calculated an effective sample size according to 10 events per independent variable principle[(12)].

Normally distributed continuous variables were expressed as mean ± standard deviation (SD), if they were normally distributed and compared using the independent-samples t-test. Abnormally distributed continuous variables were expressed as median (interquartile range (IQR)), and compared using the independent-samples nonparametric test. Categorical variables were expressed as frequency (percentage) and compared using the Chi-square test. Univariate and multivariate analyses were performed by logistic regression. Statistical analysis was performed using the SPSS 26.0 software (IBM, Armonk, NY, USA). $P < 0.05$ was considered statistically significant.

4 Results

From November 2021 to January 2022, a total of 106 patients were screened and performed ultrasonic measurements.

4.1 Patient characteristics

The average age of the patients was 62.72 ± 12.10 years old, and 40.6% (n = 43) of them were men. 67.9% (n=72) had a medical history of hypertension, 20.8% (n=22) were diabetes, and 34.0% (n=36) were CHD. The mean ± SD of the diameter of the radial artery was 2.22 ± 0.41mm. The mean ± SD of the diameter of the distal radial artery was 2.0586 ± 0.33mm. There was a significant difference in the diameter of the radial artery and the distal radial artery (P = 0.002). The mean difference in size between radial artery and distal radial artery was 0.16 mm. The distal radial artery showed a mean diameter reduction of about 7.2%. The diameter of the distal radial artery in males and females was 0.217 ± 0.031, 0.198 ± 0.033, respectly (P = 0.003). According to the mean of the diameter of the distal radial artery, the patients were divided into two groups——diameter [?] 2.0586 mm group (n = 53) and diameter < 2.0586 mm group (n = 53). Patients' characteristics are presented in Table 1.

4.2 Univariate and multivariate logistic regression analysis

The male was 25.5% (n=27) in the diameter [?] 2.0586 mm group and 15.1% (n=16) in the diameter < 2.0586 mm group (OR = 2.401, P = 0.031). The percentage of weight [?] 63 kg in the diameter [?] 2.0586 mm group was larger than the diameter < 2.0586 mm group (OR = 2.325, P = 0.034). By comparing the two groups, the related factors and independent predictors of the distal radial artery diameter [?] 2.0586 mm were obtained. Male gender, height [?] 160 cm, weight [?] 63 kg, body mass index (BMI) [?] 24 kg/m2, and body surface area (BSA) [?] 1.6573 m2 were related factors. Male gender and BMI [?] 24 kg/m2 were independent predictors. Both BMI and BSA were calculated according to height and weight, so we did not carry out multivariate logistics regression for them at the same time. We put them into multivariate logistics regression respectively. Therefore there were three models (Table 2).

5 Discussion

The diameter characteristics of the distal radial artery is very important for the dTRA, that can help clinicians to select the patients who is suitable for the dTRA.

There may be differences in the diameter of the distal radial artery in different population. In the PubMed database, we retrieved 10 articles that had published before 14 February 2022 and had reported the diameter of the distal radial artery by ultrasound measurement[6, 10, 11, 13-19], Table 3. As we can see from the table, the diameter of the distal radial artery ranges from 1.70 +- 0.5mm to 2.99 +- 0.60mm. Lee et al.'s study [11] showed that the mean distal radial artery diameters were 2.43 +- 0.44 mm (men), and 2.15 +- 0.38 mm (women) in the right hand and 2.47 +- 0.45 mm (men), and 2.18 +- 0.39 mm (women) in the left hand. And the distal radial artery of women were significantly smaller than men (P < 0.001). Meo et al.'s study[10] showed that mean distal radial artery diameters of males were 2.124 +- 0.544 mm, while the mean distal radial artery diameters of females were 1.834 +- 0.460 mm. Males have a larger caliber of distal radial artery (p < 0.001). In our study, the diameter of the distal radial artery in males and females was 0.217 +- 0.031, 0.198 +- 0.033, respectly (P = 0.003).

It's necessary to find the related factors and independent predictors of the diameter of the distal radial artery. Lee et al.'s study[11] demonstrated that female gender, low BMI, and low BSA were significant predictors of the distal radial artery diameter < 2.3 mm. Meo et al.'s study [10] showed that among factors, such as gender, hypertension, hyperlipidemia, BMI > 30 kg/m2, and diabetes, BMI and male gender were related factors of distal radial artery diameter, and men with BMI > 30 kg/m2 had a larger distal radial artery diameter. In our study, male, height [?] 160 cm, weight [?] 63 kg, BMI [?] 24 kg/m2, and BSA [?] 1.6573 m2 were the related factors of the distal radial artery diameter [?] 2.0586 mm, and male gender and BMI [?] 24 kg/m2 were its independent predictors.

6 Limitations

The present study has some limitations. First, the sample size of the study was small. Second, this study was a single-center study.

7 Conclusions

Male gender and BMI [?] 24 kg/m2 patients may have a larger distal radial artery diameter.

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Data availability

All data generated or analysed during this study are included in this published article.

Declaration of conflicting interests

The Author(s) declare(s) that there is no conflict of interest.

Research ethics and patient consent

This study was approved by the Ethics Committee of Ganzhou Hospital of Guangdong Provincial People's Hospital and ganzhou Municipal Hospital (Ganzhou city, China)

Author contributions

Weibin Liu, Lin Ma, and Huaxiu Cai are co-first authors. Jun Cao and Gang Cao are co-corresponding authors. This study was designed by Weibin Liu, Jun Cao, Fang Pei, Gang Cao. Data entry and verification by Yin Zheng and Yongkang Wen; Ultrasonic measurement was performed by Lin Ma. Statistical analysis was conducted by Huaxiu Cai.

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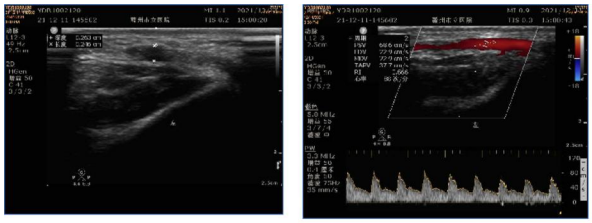
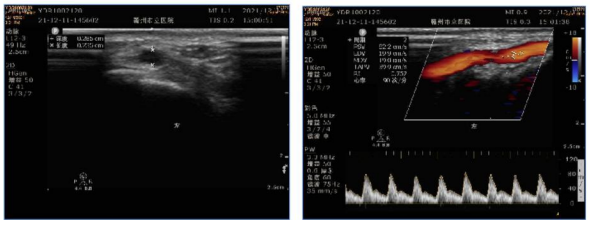
Figure Lgeneds

Figure 1 ultrasound measurement



the radial artery



the distal radial artery

Table 1 population characteristics

Characteristic
The number of cases
Male, n (%)
Age (years old)
Height, cm
Weight, kg
BMI, kg/m2
BSA, m2
Hypertension, n (%)
Diabetes, n (%)
CHD, n (%)
AF, n (%)
Cerebral infarction, n (%)
Peripheral arterial disease, n (%)
Smoking, n (%)
Pulse rate on admission, beats/min
SBP on admission, mmHg
DBP on admission, mmHg
FBG, mmol/l
TC, mmol/l
TG, mmol/l
Diameter of the radial artery, mm
Depth of the radial artery, mm
PSV at the radial artery, cm/s
Diameter of the distal radial artery, mm
Depth of the distal radial artery, mm
PSV at the distal radial artery, cm/s

Notes: Data in the table are expressed as mean ± SD or number (percentage). BMI: body mass index BSA: body surface a

Table 2 Univariate and multivariate logistic regression analysis

Gender

Male	
Female	
Age, years old	
65	
< 65	
Height, cm	
160	
< 160	
Weight, kg	
63	
< 63	
BMI, kg/m2	
24	
< 24	
BSA, m2	
1.6573	
<1.6573	
Hypertension	
Diabetes	
CHD	
AF	
Cerebral infarction	
Peripheral arterial disease	
Smoking	
FBG, mmol/l	
TC, mmol/l	
TC[?] 5.20	
TC<5.20	
TG, mmol/l	
TG[?] 1.70	
TG<1.70	

Notes: BMI: body mass index BSA: body surface area CHD: coronary heart disease AF: atrial fibrillation FBG: fasting bloo

Table 3 The diameter of the distal radial artery of different countries	**Table 3 The diameter of the distal r**
Study	Country
Lee et al. [13]	Korea
Norimatsu et al. [14]	Japan
Naito et al. [15]	Japan
Hadjivassiliou et al. [16]	Canada
Mizuguchi et al. [17]	Japan
Yu et al. [18]	China
Kawamura et al. [19]	Japan
Meo et al. [10]	Italy
Eid et al. [6]	Mexico
Lee et al. [11]	Korea