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The effect of right conventional radial artery access site and left distal radial artery access site on quality of life in coronary angiography: Which route is more appropriate?

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ABSTRACT

Objectives: There are not many studies comparing the right conventional and left distal radial (anatomical snuffbox) access in coronary angiography (CAG) or percutaneous coronary intervention (PCI) in terms of patient satisfaction and complications; therefore, in this study, we planned to compare these two approaches and determine the ideal radial access site for the patients.

Patients and methods: A total of 120 patients (80 males, 40 females; mean age: 59.2±11.7 years; range, 18 to 90 years) who underwent CAG or PCI via the radial artery between February 2022 and April 2022 were included in the prospective observational study. The patients were divided into right conventional radial artery access (Group 1; n=68) and left distal radial artery (access (Group 2; n=52) groups.

Results: The rate of minor bleeding was higher in the right conventional access group compared to the left distal access group (16.2% *vs.* 3.8%; p=0.031). Major bleeding, hand ischemia, and radial artery occlusion were not observed in the study population. The rate of patients who had pain that disrupts daily activities was statistically higher in Group 1 than in Group 2 (17.6% *vs.* 5.8%). The patients in Group 2 were more satisfied with the transradial CAG/PCI compared to Group 1 (94.3% *vs.* 66.2%; p=0.001).

Conclusion: Left distal radial artery access from the anatomic snuffbox was a safer method than right conventional radial artery access for CAG or PCI. Patients were more satisfied with the left distal radial access than the right conventional radial access.

Keywords: Anatomic snuffbox, complication, quality of life, radial access.

Coronary artery disease (CAD) is the leading cause of death worldwide. The development of techniques and devices in percutaneous coronary interventions (PCI) performed by coronary angiography (CAG) for the diagnosis and treatment of CAD has significantly reduced the mortality rate due to CAD.[1]

Coronary angiography and PCI can be performed via the femoral, brachial, and radial arteries. Among them, the most preferred method of access is the femoral artery. However, studies have shown that femoral access is associated with high rates of vascular and bleeding complications.[2-4] The advantages of transradial access include less risk of bleeding, lower morbidity, lower total hospital costs, early discharge, higher patient comfort, and lower risk of ischemia in the hand due to double blood supply.[5]

In one study, a low overall incidence of complications was reported by transradial access, and the recovery times were shorter compared to transfemoral access.[6] In addition, it was determined that most patients (94%) would choose to perform subsequent procedures this way.[6] Transradial access has recently started being widely used by many centers in CAG.

In CAG and PCI procedures, vascular complications can occur in radial access, although the radial access is a safer method compared to the femoral access. Symptomatic radial artery occlusion (RAO), nonocclusive radial artery injury, and radial artery spasms are common complications of the radial access.[7] Pseudoaneurysm formation and radial artery

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perforation have been reported as rare complications.[8] Distal radial access is recommended due to a lower risk of local complications compared to standard radial access, particularly due to the lower incidence of RAO and better comfort for both the patient and the operator.[9]

There are studies that include the safety, effectiveness, and patient satisfaction of the radial and femoral approaches.[10] However, there are not many studies comparing CAG performed with the conventional and left distal radial (anatomical snuffbox) access in terms of patient satisfaction and complications. Therefore, in our study, we planned to compare the radial access sites in terms of patient satisfaction and complications and determine the ideal radial access site in patients who underwent CAG or PCI.

PATIENTS AND METHODS

One hundred and twenty patients (80 males, 40 females; mean age: 59.2±11.7 years; range, 18 to 90 years) who were scheduled for CAG or PCI due to the diagnosis of chronic coronary syndrome at the Department of Cardiology of three institutions between February 2022 and April 2022 were included in the prospective observational study. The patients were divided into right conventional radial artery access (Group 1) and left distal radial artery access (Group 2) groups according to the access site. Patients with palpable conventional or distal radial pulses were included in the study. Patients with a nonpalpable conventional or distal radial pulse, previous history of CAG via radial access, severe forearm artery malformation, history of coronary artery bypass graft or radial artery use, history of infection at the access site, contrast allergy, severe chronic renal failure, severe liver failure, active malignancy were excluded from the study. Age, sex, body mass index (BMI), blood pressure, smoking history, comorbid diseases, and treatments of the patients were recorded in the case report form. Echocardiographic parameters and laboratory results were checked from the system.

Operators had at least two years of experience in both conventional and distal radial intervention. It was left to the discretion of the operator whether the intervention was done by the conventional or distal radial access. Allen's test was not applied to the patients before the procedure to not affect the patient selection and as it is not routinely used in clinical practice.

Questionnaires were conducted to evaluate whether the patients were satisfied with the CAG procedure performed through the radial artery, whether they would recommend this method to their relatives who might need CAG, and whether the patients experienced pain that limited their daily activities after this procedure. Questionnaires were asked to the patients face-to-face or by phone/mail.

Radial intervention procedure

In the case of right conventional radial access, the patient's right arm was placed comfortably on a side panel. In the left distal radial access, the patient's left arm was placed on the abdomen, and the left hand was placed on the right groin with the puncture area. Appropriate sterilization was provided before radial artery puncture. Afterward, local anesthesia with 2-3 mL of 2% lidocaine was applied to the access site. The radial artery was punctured with a 20 G needle at a 45-degree angle. Coronary angiography was performed with a 5F right-left diagnostic catheter. The guiding catheters used in the PCI procedure were 6F for both sides. A 6F sheath was used in all patients. This situation eliminated the effect of the study results depending on the sheath size.

For the prevention of radial artery vasospasm and thrombosis, a mixture of heparin and isosorbide dinitrate was administered through the sheath in a similar account to all patients. Catheter advancement was performed with a standard 0.035 guidewire. After the sheath was removed after the procedure, manual compression was applied to the access site in all patients to ensure hemostasis. During and after the procedure, the patient's complaints and site complications were evaluated.

Statistical analysis

Analyses were performed using the IBM SPSS version 25.0 software (IBM Corp., Armonk, NY, USA). The suitability of numerical variables to normal distribution was examined using the Kolmogorov-Smirnov test. Numerical variables are expressed as the mean and standard deviation. Categorical variables were presented as numbers (n) and percentages (%). To compare the two groups in terms of numerical variables, the independent samples t-test was used if the data were normally distributed, and the

Mann-Whitney U test was used for the nonnormally distributed data. The relationship between categorical variables was examined using the Pearson chi-square test and Fisher exact test. The significance level was accepted as $p<0.05$.

RESULTS

The mean BMI was 27.48±4.63. No statistically significant difference was found between the groups in mean age (59.3±11.3 *vs.* 59.1±11.7 years; p=0.915), male-to-female ratio (67.6 *vs.* 65.4; p=0.794), and mean BMI (27.28±3.63 *vs.* 27.74±5.70; p=0.592). The demographic data of the patients are presented in Table 1. Twenty-one (30.9%) patients in Group 1 and 14 (26.9%) patients in Group 2 underwent both CAG and PCI (p=0.636).

There were no statistically significant differences between the groups in terms of hypertension (57.4% *vs.* 63.5%; p=0.498), diabetes mellitus (32.4% *vs.* 32.5%; p=0.487), hyperlipidemia (42.6% *vs.* 32.7%; p=0.266), and anemia (7.3 *vs.* 11.5%; p=0.431). The most common comorbid diseases were hypertension (60%) and CAD (47.5%) (Table 2).

The mean hemoglobin value was 13.58±1.92 in Group 1 and 13.55±2.29 in Group 2, while the mean LDL value was 110.98±38.07 in Group 1 and 99.06±37.95 in Group 2. In the echocardiography, the mean left ventricular ejection fraction of the patients was 54.87%. The mean left ventricular ejection fraction was 56.10±7.29 in Group 1 and 53.27±9.54 in Group 2, and there was no statistical difference. No significant difference was found in drug use, particularly in preoperative anticoagulant and antiaggregant use, except for aldosterone antagonists. The laboratory findings of the patients and treatments are summarized in Tables 3 and 4.

According to the access site, minor bleeding was the most common local complication (10.8%). The rate of minor bleeding was higher in patients using the right conventional radial access compared to those using the left distal radial access (16.2% *vs.* 3.8%; p=0.031). No major bleeding was observed in any of the patients. A pseudoaneurysm was observed in two patients in Group 1. Hand ischemia or RAO was not observed in any patient. Although the radial spasm rate was higher in the left distal radial group compared to the right conventional radial group,

Table 1
Demographic and clinical characteristics of the study population

	Right conventional (n=68)			Left distal (n=52)			Total (n=120)			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			59.31±11.32			59.08±12.37			59.21±11.74	0.915
Sex										
Male	46	67.6		34	65.4		80	66.7		0.794
BMI			27.28±3.63			27.74±5.70			27.48±4.63	0.592
SBP (mmHg)			138.49±18.05			142.19±20.65			140.09±19.23	0.297
DBP (mmHg)			78.99±10.88			80.90±15.28			79.82±12.95	0.423
Heart rate (/min)			75.82±11.78			78.27±18.26			76.88±14.92	0.376
Cigarettes	24	35.3		14	26.9		38	31.7		0.329
Alcohol	18	26.5		12	23.1		30	25		0.671
Chest pain	52	76.5		26	50		78	65.0		**0.003**
Palpitation	10	14.7		5	9.6		15	12.5		0.403
Dyspnea	29	42.6		16	30.8		45	37.5		0.183
Presyncope	7	10.3		2	3.8		9	7.5		0.184
Syncope	3	4.4		0	0		3	2.5		0.125
Type of procedure-PCI	21	30.9		14	26.9		35	29.2		0.636

SD: Standard deviation; BMI: Basal metabolic index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure, PCI: Percutanous coronary intervention.

Table 2
Comorbid diseases in the study population

	Right conventional (n=68)		Left distal (n=52)		Total (n=120)		
	n	%	n	%	n	%	*p*
Hypertension	39	57.4	33	63.5	72	60.0	0.498
Diabetes mellitus	22	32.4	20	38.5	42	35.0	0.487
Previous CAD history	37	54.4	20	38.5	57	47.5	0.083
Hyperlipidemia	29	42.6	17	32.7	46	38.3	0.266
Atrial flutter/fibrillation	6	8.8	5	9.6	11	9.2	0.882
Stroke/TIA	2	2.9	2	3.8	4	3.3	0.784
Peripheral artery disease	6	8.82	4	7.69	10	8.34	0.824
Thyroid disease	7	10.3	1	1.9	8	6.7	0.069
COPD	3	4.4	5	9.6	8	6.7	0.257
CRF	8	11.8	4	7.69	12	10	0.461
Anemia	5	7.3	6	11.5	11	9.2	0.431

CAD: Coronary artery disease; TIA: Transischemic attack; COPD: Chronic obstrcutive pulmonary disease; CRF: Chronic renal failure.

Table 3
Biochemical and imaging findings of the patients

	Right conventional (n=68)	Left distal (n=52)	Total (n=120)	
	Mean±SD	Mean±SD	Mean±SD	*p*
Hemoglobin (g/dL)	13.58±1.92	13.55±2.29	13.57±2.08	0.936
Hematocrit	39.85±4.99	39.99±6.10	39.9±5.48	0.891
Platelet (10^9/L)	255.10±81.17	272.37±101.46	262.65±90.59	0.305
WBC ($\times10^9$/L)	8.07±2.35	8.89±2.40	8.43±2.40	0.063
Total cholesterol (mg/dL)	186.67± 47.28	172.71±38.97	180.58±44.22	0.90
Triglyceride (mg/dL)	157.49±110.05	147.16±57.40	152.94±90.55	0.544
HDL (mg/dL)	44.68±11.87	44.24±11.39	44.49±11.61	0.838
LDL (mg/dL)	110.98±38.07	99.06±37.95	105.74±38.31	0.096
Creatinine (mg/dL)	1.13±1.02	1.01±0.56	1.08±0.85	0.440
Fasting glucose (mg/dL)	117.20±39.71	129.28±58.61	122.50±49.04	0.193
TSH (mU/L)	2.27±2.05	1.96±0.94	2.11±1.57	0.351
T4 (ng/dL)	1.23±0.26	1.26±0.22	1.25±0.24	0.669
Sodium (mEq/L)	138.78±2.79	138.96±2.50	138.86±2.66	0.712
Potassium (mmol/L)	4.51±0.43	4.57±0.43	4.54±0.47	0.449
LVEF (%)	56.10±7.29	53.27±9.54	54.87±8.42	0.068
sPAP (mmHg)	24.15±11.36	25.17±12.94	24.59±12.02	0.645

SD: Standard deviation; WBC: White blood cell; HDL: High density lipoprotein; LDL: Low density lipoprotein; TSH: Thyroid stimulating hormone; LVEF: Left ventricular ejection fraction; sPAP: Systolic pulmonary artery pressure.

there was no statistically significant difference between the groups (7.7% *vs.* 4.4%; p=0.447). Complication rates according to the access sites were summarized in Table 5.

The rate of patients who stated that they experienced anxiety during the procedure was statistically higher in Group 1 than in Group 2 (19.1% *vs.* 3.8%). The majority of the patients in

Table 4
Treatment

	Right conventional (n=68)		Left distal (n=52)		Total (n=120)		
	n	%	n	%	n	%	*p*
Betablockers	35	51.5	24	46.2	59	49.2	0.564
ACEi's	15	22.1	13	25.0	28	23.4	0.706
ASA	39	57.4	26	50.0	65	54.2	0.423
Clopidogrel	10	14.7	9	17.3	19	15.8	0.699
Ticagrelor	1	1.47	2	3.8	3	2.5	0.409
Prasugrel	2	2.94	0	0	2	1.67	0.212
Oral anticoagulant	7	10.3	2	3.8	9	7.5	0.184
Long acting nitrates	1	1.47	2	3.8	3	2.5	0.409
Statin	24	35.3	10	19.2	34	28.3	0.053
ARBs	6	8.8	4	7.7	10	8.3	0.824
CCB	6	8.8	6	11.5	12	10	0.623
Diuretic	3	4.4	0	0	3	2.5	0.125
Aldosterone antagonist	2	2.94	7	13.5	9	7.5	**0.030**
Digoxin	1	1.47	1	1.9	2	1.6	0.848
OAD	13	19.1	14	26.9	27	22.5	0.310
Insulin	9	13.2	2	3.8	11	9.2	0.077

ACEi: Angiotensin converting enzyme inhibitor; ASA: Acetyl salicylic acid; ARB: Angiotensin receptor blocker; CCB: Calcium channel blocker; OAD: Oral antidiabetic.

Table 5
Comparison of access site complications between groups

	Right conventional (n=68)		Left distal (n=52)		Total (n=120)		
	n	%	n	%	n	%	*p*
Minor bleeding	11	16.2	2	3.8	13	10.8	0.031
Pseudoaneurysm	2	2.9	0	0	2	1.7	0.212
Hematoma	3	4.4	0	0	3	2.5	0.125
Radial spasm	3	4.4	4	7.7	7	5.8	0.447
Occlusion	0	0	0	0	0	0	-
Hand ischemia	0	0	0	0	0	0	-
Major bleeding	0	0	0	0	0	0	-

both groups stated that they did not have any pain during the procedure. The number of patients who had mild and moderate pain was higher in Group 1 than in Group 2 (p=0.047). The rate of patients who had pain that disrupts daily activities was statistically higher in Group 1 compared to Group 2 (17.6% *vs.* 5.8%; p=0.043). When we asked the patients whether they were satisfied with the CAG procedure performed through the radial artery, the group that underwent left distal radial access stated that they were satisfied with the procedure, which had a higher rate than the group that underwent right radial access (94.3% *vs.* 66.2%; p=0.001). When we asked the patients whether they would recommend the transradial CAG method to their relatives if their relatives required CAG, the left distal radial group answered yes more frequently than the right conventional radial access groups,

Table 6
Responses to the questionnaire according to radial access site

	Right conventional (n=68)		Left distal (n=52)		Total (n=120)		
	n	%	n	%	n	%	*p*
Did you have anxiety during the procedure?, yes	13	19.1	2	3.8	15	12.5	**0.012**
Did you have pain during the procedure?							**0.047**
0: Didn't happen	48	70.6	47	90.5	95	79.1	
1: Mild	12	17.6	2	3.8	14	11.7	
2: Moderate	7	10.3	2	3.8	9	7.5	
3: Severe	1	1.5	1	1.9	2	1.7	
Did you have pain in your hand after the procedure that disrupted daily activities?, yes	12	17.6	3	5.8	15	12.5	**0.043**
Were you satisfied with the coronary angiography procedure performed via the arm?							**0.001**
1: Yes	45	66.2	49	94.3	94	78.3	
2: Undecided	18	26.5	2	3.8	20	16.7	
3: No	5	7.3	1	1.9	6	5.0	
If your relatives need angiography, would you recommend radial access for coronary angiography?							**0.001**
1: Yes	42	61.8	48	92.3	90	75.0	
2: Undecided	22	32.3	4	7.7	26	21.7	
3: No	4	5.9	0	0	4	3.3	

which was statistically significant (p=0.001). Survey data are provided in Table 6.

DISCUSSION

This study is one of the rare studies in the literature in terms of comparing the effects of conventional radial access and left distal radial access on patient satisfaction and quality of life in CAG or PCI. With the results of our study, it has been revealed that the risk of major complications, such as occlusion, hand ischemia, and compartment syndrome, is minimal when the CAG procedure is performed through the left distal radial artery by experienced operators and the necessary precautions are taken. It has been revealed that the left distal radial artery access for CAG provides high patient comfort and satisfaction by not causing much pain in daily activities, and the patients can recommend it to their relatives. According to the results of this survey, the left distal radial access appears to be superior to the right radial access in terms of patient satisfaction.

Compared to the right conventional approach, left distal radial access has several significant benefits. Since the dominant hand used by the majority of the population is the right hand, patients who undergo left distal access are not disturbed by the limited mobility of their right hand after the intervention.[11] It will be a comfortable posture for patients to place their left hands close to their navel or right groin throughout the procedure.[12] In addition, in left distal access, the doctor can work at a safe distance from the radiation source.[13]

The radial artery has a superficial course, and thus hemostasis can be easily achieved after the procedure. The end of the radial artery anastomoses with the deep palmar branch of the ulnar artery, forming a deep palmar arch with abundant collateral circulation. In addition, hand ischemia is prevented when occlusion occurs in the radial artery due to the double blood supply of the hand.[4] The incidence of ischemia or necrosis of the hand after transradial artery puncture is low.[14] In our study, no hand ischemia or necrosis developed in any patient. In a study that evaluated the efficacy and safety of distal radial and conventional radial approaches during CAG with 200 patients, hemostasis time was found to be shorter in patients who underwent distal radial access compared to patients who underwent conventional radial access (568±462 *vs.* 841±574; p=0.002).[15] According to

the results of this study, the distal radial access is associated with lower successful cannulation rates and shorter manual hemostasis time compared to the conventional radial access. In an observational multicenter study, 177 patients were divided into two groups as conventional radial (n=95) and distal radial (n=82) interventions.[9] Radial artery occlusion was detected by ultrasonography in three (3.1%) patients in the conventional group and none of the patients in the distal group (p=0.25). Vasospasm was found to be similar between the two groups (p=0.54). In our study, no statistically significant difference was found between the two groups in terms of complications other than minor bleeding. We believe that the reason why minor bleeding occurs less in the distal radial group was owing to the bones around the distal radial artery pressing to the artery.

In our study, a similar amount of nitroglycerin was given to the study population during the procedure to prevent radial artery spasms. However, radial artery spasms still occurred, and there was no statistically significant difference between the groups in terms of radial artery spasms. Catheter entrapment associated with radial artery spasms is rare during transradial CAG or PCI, and it has been demonstrated that forearm heating can effectively reverse severe and resistant vasospasm of the radial artery.[16] Accordingly, we applied forearm warming and intra-arterial nitroglycerin readministration in patients who developed radial spasms during the procedure.

The use of the radial artery in coronary artery bypass surgery is becoming increasingly common. It is known that mid-and long-term patency rates are superior when compared to saphenous vein grafts.[17] It has been stated that it should be used as a second graft for complete arterial revascularization, reoperation, and without retraction of the radial artery in young patients.[17] In our study, it was revealed that the distal radial artery should be preferred over the right radial conventional access in CAG or PCI procedures, despite the possibility that the radial artery can be used in future coronary artery bypass surgeries.

In a study in which 100 cases with variable indications for coronary interventions were divided into distal radial access (n=50) and conventional radial access (n=50), the safety profile parameters had statistically significant differences in favor of the distal group in terms of postoperative hematoma, arteriovenous fistula, postprocedural pain, and compression time.[8] Although it was higher in the conventional group, no statistically significant differences were found regarding RAO.[18] In our study, we determined that the distal radial access is an easily applicable and safe method for CAG and PCI compared to the right conventional radial access, and the patients are more satisfied. Therefore, distal radial access in CAG and PCI may be the first choice for interventional cardiologists in the near future.

The main limitation of the study is the small sample size. However, despite the limited number of patients, significant results were demonstrated in favor of the left distal radial artery access being a safe and preferable method for CAG or PCI. In our study, radial Doppler ultrasonography was performed after the procedure; thus, the radial artery diameter and Doppler flow could not be evaluated before the procedure.

In conclusion, left distal radial artery access was a safer method and had less complication risk for CAG and PCI compared to right conventional radial artery access. Left distal radial artery approach provided high patient comfort and satisfaction, did not cause much pain in daily activities, and patients claimed they would recommended it to their relatives for CAG or PCI.

Ethics Committee Approval: The study protocol was approved by the Bakırcay University Non-Invasive Clinical Research Ethics Committee (Date No: 02/16/2022-492). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept: M.K.; Design: M.K., O.Ş.; Control/supervision: H.D.; Data collection and/or processing: O.Ş., M.K., H.D.; Analysis/and/or interpretation: O.Ş.; Literature review: M.K.; Writing the article: M.K.; Critical review: H.D.

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