THE ANATOLIAN JOURNAL OF CARDIOLOGY

Official journal of the TURKISH SOCIETY OF CARDIOLOGY

Can Distal Radial Access Replace Conventional Radial Access for Coronary Catheterization? A Study Comparing Puncture Time, Attempts, Patient and Operator Comfort

ABSTRACT

Background: To compare distal (dTRA) and classical (cTRA) transradial approaches for coronary catheterization with respect to puncture attempts, puncture time, operator and patient comfort, and safety outcomes.

Methods: In this prospective observational study, patients undergoing coronary catheterization for standard indications via dTRA or cTRA approaches from July 2019 to May 2020 were included. Clinicodemographic and laboratory characteristics were recorded. Puncture time, number of puncture attempts, operator and patient comfort on the visual analogue scale (VAS), and access site complications like hematoma and radial artery occlusion were recorded. Patients were analyzed in the same group as the initial puncture, even if there was a cross-over.

Results: Of the 130 patients (40.8% women), 50.8% and 49.2% belonged to dTRA and cTRA groups, respectively. dTRA group required more than one puncture attempt more frequently than cTRA group (30.3% vs. 15.6%; $P = .047$); consequently, puncture time was longer (60s vs. 50s; $P = .031$, respectively). However, puncture time was comparable if the puncture was successful in the first attempt (47.5s vs. 45s; $P = .492$). Patient comfort was comparable (7.2 ± 0.9 vs. 7.2 ± 1.2; $P = .852$), but operator comfort was more with cTRA approach (8.3 ± 1.6 vs. 8.8 ± 1.2; $P = .048$). Post-procedure, cTRA had more minor bleeding than dTRA approach. There was no major bleeding in either group. The occurrence of radial artery occlusion was comparable in both groups.

Conclusion: Although dTRA needed more attempts for successful puncture, puncture time was comparable with cTRA when puncture was successful on the first attempt. Therefore, one attempt at dTRA puncture could be a reasonable approach in patients undergoing coronary catheterization.

Keywords: Coronary catheterization, distal radial artery, transradial access, vascular access site

ORIGINAL INVESTIGATION

Kanhai Lalani

Tom Devasia

Ganesh Paramasivam

Department of Cardiology, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, Karnataka, India

Corresponding author:
Ganesh Paramasivam
✉ ganeshbmc@gmail.com or ganesh.p@manipal.edu

Received: February 25, 2024
Accepted: May 31, 2024
Available Online Date: July 23, 2024

Cite this article as: Lalani K, Devasia T, Paramasivam G. Can distal radial access replace conventional radial access for coronary catheterization? A study comparing puncture time, attempts, patient, and operator comfort. *Anatol J Cardiol.* 2024;28(9):454-460.

DOI:10.14744/AnatolJCardiol.2024.4363

INTRODUCTION

The first crucial step for interventional cardiologists performing coronary catheterization is selecting the appropriate vascular access site. The transradial access site has emerged as the gold standard, aligning with the guidelines set by the European Society of Cardiology in 2015. This approach offers a multitude of advantages over the transfemoral route, including diminished access site-related complications, reduced bleeding incidents, shorter hospital stays, and decreased risks of stroke and mortality.[1]

A novel method introduced by Kiemeneij[2] has garnered attention within the field of coronary intervention. This innovation involves the utilization of the left distal radial artery (dTRA), positioned within the anatomical snuffbox (AS). Notably, the puncture site in the dTRA lies distal to the origin of the superficial branch of the radial artery (RA), providing several benefits. These advantages encompass the preservation of antegrade flow to the hand, reduced risk of ischemia, efficient

hemostasis, and an enhanced sense of operator comfort compared to the classic left radial artery (cTRA) approach.[3-5]

While existing literature has substantiated the practicality and safety of dTRA, a notable focus has been placed on the left transradial approach.[2,6-11] However, little attention has been directed toward research comparing the right dTRA with the right cTRA approach.[12] This prompted our investigation, designed to elucidate whether the right dTRA can aptly serve as the standard access site in lieu of the right cTRA, thereby preserving the latter for potential future reinterventions. Addressing this critical knowledge gap, our study examines the ease of the procedure, number of attempts, time to establish access, patient and operator comfort.

METHODS

Study Population and Design

This prospective, single-center, observational study was conducted at a tertiary care hospital in South India. Patients aged > 18 years undergoing coronary catheterization through either the dTRA or cTRA approach from the right forearm as a part of standard care were included. The study protocol was approved by the Institutional Ethics Committee and was registered with the Clinical Trials Registry–India (reg. number. CTRI/2019/06/019898). This study was conducted in accordance with the principles of the Declaration of Helsinki.

Eligible patients were informed in detail about the study in their own language. Informed consent was obtained from patients who were willing to participate in the study. Patients with an absent right radial pulse, upper extremity peripheral vascular disease, previous coronary catheterization via a right radial artery, and procedures requiring intra-aortic balloon counter-pulsation (IABP) or rotablation were excluded from the study. Pregnant, critically ill, physically/mentally challenged, and non-consenting patients were also excluded.

The study recorded the baseline characteristics of patients, including their risk factors, comorbidities, and reason for catheterization. The procedural characteristics were also noted, such as the site of puncture, number of attempts, time taken, size of sheath used, and success rate. Additionally, the medications used, type of coronary procedure, catheter/guide exchanges, and their sizes were documented. The study also recorded the total heparin dosage, contrast volume, procedural and radiation time, and radiation exposure.

The vascular access technique is explained in detail in the supplementary material S1. Following the procedure, the sheath was removed, and a compression bandage was placed around the access site for 3 to 4 hours in the dTRA group and 4 to 6 hours in the cTRA group to achieve hemostasis. If any bleeding or hematoma was observed during the removal of the bandage, compression was maintained for an additional 30-60 minutes. The postprocedural hemostasis method and time, as well as any complications such as hematoma, bleeding, radial artery occlusion, or any other symptoms at 24 hours, were recorded. Standard guideline-directed medications were administered to all study patients by the treating physician.

Study Definitions

Puncture time was defined as the time after the completion of local anesthesia to the successful sheath placement into the radial artery. It includes the time taken to puncture the artery, place the guidewire, and slide the sheath over the wire. If more than one attempt was needed for a puncture, the time between the puncture attempts was also included in the puncture time. If there was a crossover to the other technique, the time taken for switching was also included in the puncture time.

A puncture attempt was counted whenever the skin was punctured, regardless of whether the attempt led to successful sheath placement or not. Attempts in which the artery could not be punctured, the wire could not be crossed, or a sheath could not be placed were also included in the count. The total number of attempts made until a successful sheath placement was achieved, even if there was a switch in the access site, was also included in the puncture attempts tally.

If 3 attempts failed, the patient was crossed over to the other technique. If a cross-over or change of access site (to the left radial or femoral) was required, it was considered to be a puncture failure.

Procedure time was defined from the time of giving local anesthesia to the time of taking the last cine image of the catheterization procedure.

The visual analogue scale (VAS) (scale range 1-10) was used to assess comfort for patients and operators.[13,14] On this scale, a rating of 1 indicates the least comfort, while a rating of 10 indicates the most comfort.

Bleeding events were classified as major or minor bleeding according to criteria defined in the ESSENCE trial.[15] Local hematomas were graded according to a specific Early Discharge After Transradial Stenting of Coronary Arteries Study (EASY) grade.[16,17]

Patients were analyzed in the initial group even if they crossed over to the other group.

HIGHLIGHTS

- We compared distal (dTRA) and classical transradial access (cTRA) for angiography.
- dTRA is feasible and effective but may need more puncture attempts than cTRA.
- For the first puncture, dTRA and cTRA exhibit comparable puncture times.
- Operator comfort favors cTRA; patient comfort is similar.
- dTRA improves safety with reduced bleeding and fewer hematomas.

Study Objectives

The primary objective of the study was to compare the number of puncture attempts and puncture time between the dTRA and cTRA groups. We also compared the patient and operator comfort and safety outcomes, such as incidence of hematoma and bleeding, between the dTRA and cTRA groups.

Statistical Analysis

Categorical data were presented as frequencies and percentages. Numerical data were presented as mean and standard deviation for normally distributed data, and median and interquartile ranges for non-normally distributed data. The chi-square test was used to compare categorical variables, while the unpaired *t*-test was used for variables with a normal distribution, and the Mann–Whitney U-test was used for non-normal data. A *P*-value of less than .05 was considered statistically significant. We performed statistical analyses using IBM SPSS Statistics software, version 22 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 130 patients in whom coronary catheterization was done via the right distal radial (dTRA) or right classic radial (cTRA) approach from July 2019 to May 2020 were included. The right dTRA approach was attempted in 66 (50.8%) patients, out of which 5 (7.6%) patients were crossed over to the right cTRA group due to puncture failure. The right cTRA approach was attempted in 64 (49.2%) patients, out of which 1 (1.6%) patient was crossed over to the right dTRA group due to puncture failure (Figure 1).

Baseline Characteristics

Table 1 presents the baseline demographic characteristics of the study participants. Both groups had comparable gender distribution, mean age, weight, height, and body mass index (BMI). Among the patients who underwent cardiac catheterization, 89 (68.4%) presented with acute coronary syndrome (ACS), while 13 (10%) had chronic stable angina (CSA). Other indications for cardiac catheterization in the remaining 28 (21.5%) patients included silent ischemia, heart failure, pre-operative evaluation for cardiac and non-cardiac surgery, or valvular heart disease.

Table 1. Baseline Characteristics

Parameters	Distal Radial (n = 66)	Classic Radial (n = 64)	Total (n = 130)	*P*
Mean Age (years, mean ± SD)	56.0 ± 10.7	58.2 ± 12.3	57.1 ± 11.5	.276
Gender				.974
Male (n, %)	39 (59.1%)	38 (59.4%)	77 (59.2%)	—
Female (n, %)	27 (40.9%)	26 (40.6%)	53 (40.8%)	—
Weight (kg, mean ± SD)	67.1 ± 10.6	66.0 ± 12.9	66.6 ± 11.8	.589
Height (meter, mean ± SD)	1.6 ± 0.01	1.6 ± 0.1	1.6 ± 0.1	.773
BMI (kg/m^2, mean ± SD)	26.1 ± 3.7	25.8 ± 4.7	26 ± 4.2	.682
Indication of CAG (n, %)				
ACS	43 (65.1%)	46 (71.9%)	89 (68.4%)	—
UA	36 (54.5)	35 (54.7%)	71 (54.6%)	—
STEMI	1 (1.5 %)	2 (3.1 %)	3 (2.3%)	—
NSTEMI	6 (9.1 %)	9 (14.1 %)	15 (11.5%)	—
CSA	7 (10.6 %)	6 (9.4 %)	13 (10%)	—
Others	16 (24.2%)	12 (18.7%)	28 (21.5%)	—
Risk factors (n, %)				
Hypertension	37 (56.1%)	40 (62.5%)	77 (59.2%)	.455
Diabetes	25 (37.9%)	31 (48.4%)	56 (43.1%)	.224
PVD	2 (3%)	0 (0%)	2 (1.5%)	.496
CVA	4 (6.1%)	0 (0%)	4 (3.1%)	.119
CKD	2 (3%)	4 (6.3%)	6 (4.6%)	.437

ACS, acute coronary syndrome; BMI, body mass index; CAG, coronary angiogram; CKD, chronic kidney disease; CSA, chronic stable angina; CVA, cerebrovascular accident; NSTEMI, non-ST-elevation myocardial infarction; PVD, peripheral vascular disease; STEMI, ST-elevation myocardial infarction; UA, unstable angina.

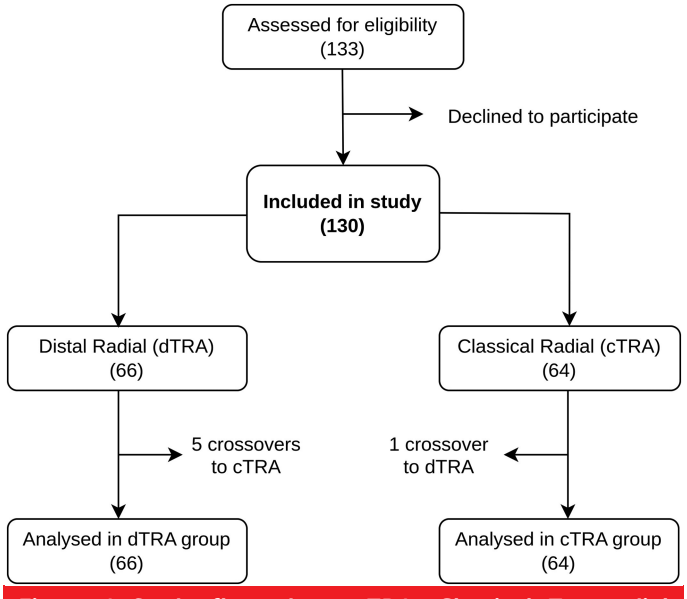

Figure 1. Study flow chart. cTRA, Classical Transradial Access; dTRA: Distal Transradial Access.

Puncture Characteristics

Overall, a higher puncture success rate was seen in the cTRA group compared to the dTRA group [63 (98.4%) vs. 61 (92.4%), *P* = .208] though it was not statistically significant. When the number of attempts needed for a successful puncture was compared, only 46 (69.7%) of dTRA punctures were successful on the first attempt compared to a 54 (84.4%) success rate in the cTRA approach (*P* = .047). More than one puncture attempt was required in 20 (30.3%) patients in the dTRA group compared to 10 (15.6%) patients in the cTRA group (*P* = .047) (Table 2).

We analyzed the factors associated with puncture failure and found that overall male gender was associated with a higher number of puncture attempts compared to women [23 (29.9%) vs. 7 (13.2%), *P* = .027, respectively]. This gender difference was seen only in the dTRA group, where men

Table 2. Puncture Characteristics

Parameters	Distal Radial (n = 66)	Classic Radial (n = 64)	Total (n = 130)	*P*
Initial vascular access site (n, %)	66 (50.8%)	64 (49.2%)	130 (100%)	–
Puncture attempts (n, %)				**.047**
One	46 (69.7%)	54 (84.4%)	100 (76.9%)	–
More than one	20 (30.3%)	10 (15.6%)	30 (23.1%)	–
Two	14 (21.2%)	9 (14.1%)	23 (17.7%)	–
Three	6 (9.1%)	1 (1.6%)	7 (5.4%)	–
Puncture time (seconds, median & IQR)	60 (40-130)	50 (40-70)	50 (40-86.3)	**.031**
Puncture time when the first attempt was successful (seconds, median & IQR)	47.5 (40-60)	45 (39.5-58.5)	45 (40-60)	.492
Final vascular access site (n, %)	62 (47.7%)	68 (52.3%)	130 (100%)	–
Puncture success (n, %)	61 (92.4%)	1 (98.4%)	6 (95.4%)	.208
Puncture failure (n, %)	5 (7.6%)	1 (1.6%)	6 (4.6%)	–
Sheath size				.793
5 F (n, %)	6 (9.1%)	5 (7.8%)	11 (8.5%)	–
6 F (n, %)	60 (90.9%)	59 (92.2%)	119 (91.5%)	–
Radial artery spasm (n, %)	2 (3%)	2 (3.1%)	4 (3.1%)	1.000

Values in bold indicate statistical significance.
IQR, Interquartile range.

(41%) needed more than one puncture attempt compared to women (14.8%). However, in the cTRA group, the number of puncture attempts was comparable among men and women [7 (18.4%) vs. 3 (11.5%), *P* = .456, respectively] (Table 3).

Overall, median puncture time was significantly higher in the dTRA group compared to the cTRA group [60 (40-130) seconds vs. 50 (40-70) seconds, *P* = .031, respectively]. However, when the puncture was successful on the first attempt, the median puncture time was comparable between the 2 groups (47.5 seconds vs. 45 seconds in dTRA and cTRA respectively, *P* = .492). Median puncture time was significantly different only when more than one puncture attempt was required (Table 2).

Once puncture was obtained and the wire was passed, the sheath could be placed with a 100% success rate in both groups, and the incidence of radial artery spasm was similar in both groups [2 (3%) vs. 2 (3.1%) in dTRA and cTRA groups respectively, *P* = 1] (Table 2).

Table 3. Gender Differences in Number of Puncture Attempts

Total (n = 130)			
Sex	**Male (n = 77)**	**Female (n = 53)**	***P***
One attempt (n, %)	54 (70.1%)	46 (86.8%)	**.027**
More than one attempt (n, %)	23 (29.9%)	7 (13.2%)	—
Two attempts	16 (20.8%)	7 (13.2%)	—
Three attempts	7 (9.1%)	0	—
Distal Radial (n = 66)			
Sex	**Male (n = 39)**	**Female (n = 27)**	***P***
One attempt (n, %)	23 (59%)	23 (85.2%)	**.023**
More than one attempt (n, %)	16 (41%)	4 (14.8%)	—
Two attempts	10 (25.6%)	4 (14.8%)	—
Three attempts	6 (15.4%)	0	—
Classic Radial (n = 64)			
Sex	**Male (n = 38)**	**Female (n = 26)**	***P***
One attempt (n, %)	31 (81.6%)	23 (88.5%)	.456
More than one attempt (n, %)	7 (18.4%)	3 (11.5%)	—
Two attempts	6 (15.8%)	3 (11.5%)	—
Three attempts	1 (2.6%)	0	—

Values in bold indicate statistical significance.

Characteristics of Coronary Catheterization Procedure

Details of the coronary catheterization procedure are summarized in Table 4. The number of catheters used, angiographic views taken, and radiation exposure were comparable between the dTRA and cTRA groups. However, the median catheterization procedure time was longer (18 minutes vs. 16.3 minutes, *P* = .019, respectively), and fewer patients underwent percutaneous coronary intervention (PCI) in the dTRA group compared to the cTRA group [1 (1.5%) vs. 7 (10.9%), *P* = .032, respectively].

Patient and Operator Comfort

The mean score on the operator's comfort scale in the cTRA group was marginally higher than in the dTRA group (8.8 ± 1.2 vs. 8.3 ± 1.6, *P* = 0.048, respectively) (Table 5). However, patient comfort was comparable on the VAS (7.2 ± 0.9 vs. 7.2 ± 1.2, *P* = .852, respectively).

Safety Outcomes

Post-procedure, hematoma occurred in 40.8% of patients, and all were grade I as per the EASY grading scale. In the dTRA group compared to the cTRA group, there were significantly fewer hematomas (24.2% vs. 57.8%, *P* = .001, respectively). Post-bandage removal, minor bleeding was significantly less in the dTRA group compared to the cTRA

Table 4. Characteristics of Coronary Catheterization Procedure

Parameters	Distal Radial (n = 66)	Classic Radial (n = 64)	Total (n = 130)	*P*
Procedure - PCI (n, %)	1 (1.5 %)	7 (10.9 %)	8 (6.2 %)	**.032**
Total no. of catheters used (n, %)				.076
One	65 (98.5%)	57 (89.1%)	—	—
More than one	1 (1.5%)	7 (10.9%)	—	—
Total no of views (median & IQR)	8 (6.75-9)	8 (7-9)	8 (7-9)	.762
Total procedure time (minutes, median & IQR)	18 (15-20.5)	16.3 (12-20)	17 (13.8-20)	**.019**
Total radiation time (minutes, median & IQR)	2.9 (1.5-4.5)	2.2 (1.6-2.9)	2.4 (1.5-3.8)	.112
Radiation exposure				
Total Air Kerma (mGy, mean ± SD)	268.3 ± 132.4	237.9 ± 129.7	253.3 ± 131.5	.189
Total DAP: (μGy*mt^2, mean ± SD)	14020.7 ± 8384.9	12816.4 ± 9381.5	13427.8 ± 8875.5	.441

Values in bold indicate statistical significance.
CAG, Coronary Angiogram; DAP, Dose Area Product; IQR, Interquartile range; PCI, Percutaneous Coronary Intervention.

Table 5. Patient and Operator Comfort and Safety Outcomes

Parameters	Distal Radial (n = 66)	Classic Radial (n = 64)	Total (n = 130)	*P*
Hematoma (EASY grade) (n, %)				**.001**
No hematoma	50 (75.8%)	27 (42.2%)	77 (59.2%)	—
Grade I	16 (24.2%)	37 (57.8%)	53 (40.8%)	—
Grade II-V	0	0	0	—
Bleeding (n, %)				**.028**
No bleeding	62 (93.9%)	52 (81.3%)	114 (87.7%)	—
Minor bleeding	4 (6.1%)	12 (18.8%)	16 (12.3%)	—
Major bleeding	0	0	0	—
Incidence of Radial artery occlusion	4 (6.1%)	3 (4.7%)	7 (5.4%)	1.000
Patient's comfort score (mean ± SD)	7.2 ± 0.9	7.2 ± 1.2	—	.852
Operator's comfort score (mean ± SD)	8.3 ± 1.6	8.8 ± 1.2	—	**.048**

Values in bold indicate statistical significance.
EASY, Early Discharge After Transradial Stenting of Coronary Arteries Study.

group (6.1 % vs. 18.8 %, *P* = .028, respectively). No major bleeding complication was noted in either group. The incidence of radial artery occlusion was comparable in both groups (6.1 % vs. 4.7 %, *P* = 1) (Table 5).

DISCUSSION

This prospective observational study aimed to compare the distal radial artery (dTRA) and classical radial artery (cTRA) access sites for coronary catheterization, focusing on puncture attempts, puncture time, operator and patient comfort, and safety outcomes. A total of 130 patients were included in the study, with 50.8% undergoing dTRA and 49.2% cTRA procedures. While both approaches exhibited high puncture success rates, dTRA required more puncture attempts and had longer puncture times. However, when the puncture was successful on the first attempt, puncture times were similar. Patient comfort was comparable, but operator comfort favored cTRA. Safety outcomes showed fewer hematomas and less minor bleeding in dTRA, with no major bleeding in either group and a similar incidence of radial artery occlusion. This study provides valuable insights into the feasibility and practicality of using dTRA as a standard access site for coronary catheterization, especially in certain clinical scenarios.

Puncture Attempts

In our study, we observed that the dTRA approach also demonstrated a high puncture success rate (92.4%) comparable with the cTRA approach (98.4%), affirming that both approaches can be effective for coronary catheterization.[1,18-21] It is noteworthy that the success rate of a single puncture attempt in dTRA (69.7%) was slightly lower than that of cTRA (84.4%), consistent with previous research (78% to 85% in the dTRA vs. 85% to 92% in the cTRA group).[1,20]

Multiple puncture attempts were more frequently required in the dTRA group (30.3%) compared to the cTRA group (15.6%), with the main reasons being difficulties in passing the wire and puncturing the artery, which could be attributed to the relatively smaller and more tortuous anatomy of the distal radial artery in the anatomical snuffbox. Additionally, differences in operator experience could have influenced the results. Our findings also revealed a patient gender-related difference in puncture attempts, with male patients in the dTRA group requiring more attempts, possibly due to the deeper location of the radial pulse in men and differences in skin thickness.[22] Taken together, these observations emphasize the importance of operator experience and careful patient selection when considering dTRA access.

Puncture Time

Puncture time, a crucial factor in coronary catheterization, was found to be slightly longer in the dTRA group compared to the cTRA group (60 seconds vs. 50 seconds, *P* = .031). This finding aligns with previous studies that reported higher puncture times in dTRA compared to cTRA.[4,12,17,23-25]

However, when puncture attempts were successful on the first try, puncture times were comparable in both groups (47.5 seconds in dTRA and 45 seconds in cTRA, *P* = .492). This indicates that puncture time was prolonged primarily when

multiple puncture attempts were needed, reaffirming the significance of puncture proficiency. In situations where time is of the essence, such as primary percutaneous coronary intervention (PCI) for ST-elevation myocardial infarction (STEMI), careful patient selection is critical to avoid unnecessary delays.

The observed gender difference in puncture attempts and puncture time, with men in the dTRA group needing more attempts, may be attributed to variations in radial artery anatomy and patient characteristics.[21] Our male patients, often laborers and farmers, exhibited thicker skin than their female counterparts, which could explain the higher number of puncture attempts required. While we did not measure exact skin thickness in our study, this observation suggests a possible avenue for future research. These gender-related differences emphasize the need for individualized decision-making when selecting the most suitable access site, considering both operator experience and patient characteristics.

Operator and Patient Comfort

In this study, we introduced a new parameter, operator comfort, measured using a VAS. The results indicated that operator comfort was marginally but significantly higher in the cTRA group compared to the dTRA group (8.8 ± 1.2 in cTRA vs. 8.3 ± 1.6 in dTRA, $P = .048$). This finding likely informs us about the potential impact of operator experience and familiarity with the classic radial approach on comfort levels. Patient comfort was comparable between the 2 groups (7.2 ± 0.9 in dTRA vs. 7.2 ± 1.2 in cTRA, $P = .852$). These results suggest that patient comfort may not significantly differ between the 2 access sites and indicate the feasibility of dTRA in ensuring patient satisfaction.

Other Findings

Apart from puncture attempts, puncture time, and comfort, our study also examined several other factors. We found that procedure time for coronary angiography (CAG) was slightly but significantly longer in the dTRA group compared to the cTRA group (approximately 18 minutes in dTRA vs. 16.3 minutes in cTRA, $P = .019$). This difference in procedure time was primarily attributed to the increased number of puncture attempts and the associated higher puncture time in the dTRA group. While this might not significantly affect elective CAG in stable patients, it becomes crucial in time-sensitive scenarios such as STEMI or cardiogenic shock, where a longer procedure time can potentially impact patient outcomes. Consequently, careful consideration of the access site is necessary, considering the operator's expertise and patient characteristics.

Safety Outcomes

The safety outcomes in our study revealed significant differences between the dTRA and cTRA groups. Notably, dTRA was associated with fewer minor bleeding events and smaller hematoma formation. No major bleeding complications were observed in either group. Moreover, the incidence of radial artery occlusion was similar in both groups. These findings suggest that dTRA may offer advantages in terms of safety outcomes, including reduced hematoma formation and minor bleeding, which can be particularly important in improving patient comfort and minimizing post-procedural complications. This could be attributed to the smaller diameter of the distal radial artery in the anatomical snuffbox, which allows for easier hemostasis and compression.

Study Limitations

This study has certain limitations that should be acknowledged. It was conducted at a single center with a relatively small study population and a nonrandomized design. However, the comparability of baseline characteristics in the studied groups adds strength to the conclusions drawn. The procedures were performed by highly skilled interventional cardiologists, which may limit the generalizability of the findings to less experienced operators. Furthermore, most of our study patients underwent only CAG, and the results regarding procedure time, radiation time, and exposure, as well as vascular complications, may not be directly applicable if PCI is performed. The assessment of radial artery occlusion post-procedure was solely based on clinical evaluation of the radial pulse and not arterial Doppler, warranting further research in this aspect.

CONCLUSION

Our study provides valuable insights into the feasibility and practicality of using the right dTRA as a standard access site for coronary catheterization. The study demonstrates that both dTRA and cTRA approaches are effective, with high puncture success rates, although dTRA may require more puncture attempts and longer puncture times. The findings highlight the importance of operator experience and individualized patient selection in choosing the most suitable access site. Moreover, our study indicates that dTRA offers advantages in terms of safety outcomes, including reduced hematoma formation and minor bleeding, which can contribute to enhanced patient comfort and minimize post-procedural complications. The decision regarding the access site should be made based on a careful assessment of the specific clinical scenario, operator experience, and patient characteristics. However, based on our findings, we recommend that one attempt at distal radial access be considered in patients undergoing coronary catheterization, especially if only coronary angiography is being planned.

Ethics Committee Approval: The study protocol was approved by the Institutional Ethics Committee (IEC: 361/2019; May 15, 2019) and was registered with the Clinical Trials Registry—India (reg. number: CTRI/2019/06/019898).

Informed Consent: Informed consent was obtained from all study participants prior to their participation in the study.

Peer-review: Externally peer reviewed.

Author Contributions: Conceptualization – K.L., G.P., T.D.; Data curation – K.L., G.P.; Formal analysis – K.L., G.P.; Funding acquisition – None; Investigation, Methodology – K.L., G.P.; Resources – K.L., G.P.; Supervision – G.P., T.D.; Validation – K.L., G.P., T.D.; Roles/Writing - original draft – K.L., G.P.; Writing – review and editing – G.P., T.D.

Acknowledgments: We thank Dr. Pankti Parikh and Dr. Indu R Rao for proofreading the manuscript and for their valuable input.

Declaration of Interests: The authors have no conflicts of interest to declare.

Funding: The authors declare that this study received no financial support.

REFERENCES

1. Sharma AK, Razi MM, Prakash N, et al. A comparative assessment of dorsal radial artery access versus classical radial artery access for percutaneous coronary angiography-a randomized control trial (DORA trial). *Indian Heart J*. 2020;72(5):435-441. [CrossRef]
2. Kiemeneij F. Left distal transradial access in the anatomical snuffbox for coronary angiography (ldTRA) and interventions (ldTRI). *EuroIntervention*. 2017;13(7):851-857.
3. Kim Y, Ahn Y, Kim I, et al. Feasibility of coronary angiography and percutaneous coronary intervention via left snuffbox approach. *Korean Circ J*. 2018;48(12):1120-1130. [CrossRef]
4. Valsecchi O, Vassileva A, Cereda AF, et al. Early clinical experience with right and left distal transradial access in the anatomical snuffbox in 52 consecutive patients. *J Invasive Cardiol*. 2018;30(6):218-223.
5. Ziakas A, Koutouzis M, Didagelos M, et al. Right arm distal transradial (snuffbox) access for coronary catheterization: initial experience. *Hellenic J Cardiol*. 2020;61(2):106-109. [CrossRef]
6. Bayam E, Kahyaoğlu M, Güner A, Zehir R, Karabay CY. Safe entry site for coronary angiography: snuff box. *Turk Kardiyol Dern Ars*. 2018;46(3):228-230. [CrossRef]
7. Alkhawam H, Windish S, Abo-Salem E. Distal radial artery access among cases with radial artery occlusion for primary percutaneous intervention. *Future Cardiol*. 2019;15(3):169-173. [CrossRef]
8. Davies RE, Gilchrist IC. Dorsal (distal) transradial access for coronary angiography and intervention. *Interv Cardiol Clin*. 2019;8(2):111-119. [CrossRef]
9. Gasparini GL, Garbo R, Gagnor A, Oreglia J, Mazzarotto P. First prospective multicentre experience with left distal transradial approach for coronary chronic total occlusion interventions using a 7 Fr Glidesheath Slender. *EuroIntervention*. 2019;15(1):126-128. [CrossRef]
10. Liontou C, Kontopodis E, Oikonomidis N, et al. Distal radial access: a review article. *Cardiovasc Revasc Med*. 2020;21(3):412-416. [CrossRef]
11. Roh JH, Lee JH. Distal radial approach through the anatomical snuff box for coronary angiography and percutaneous coronary intervention. *Korean Circ J*. 2018;48(12):1131-1134. [CrossRef]
12. Cai G, Huang H, Li F, Shi G, Yu X, Yu L. Distal transradial access: a review of the feasibility and safety in cardiovascular angiography and intervention. *BMC Cardiovasc Disord*. 2020;20(1):356. [CrossRef]
13. Soydan E, Akın M. Coronary angiography using the left distal radial approach - an alternative site to conventional radial coronary angiography. *Anatol J Cardiol*. 2018;19(4):243-248. [CrossRef]
14. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res (Hoboken)*. 2011;63(suppl 11):S240-S252. [CrossRef]
15. Cohen M, Demers C, Gurfinkel EP, et al. A comparison of low-molecular-weight heparin with unfractionated heparin for unstable coronary artery disease. *N Engl J Med*. 1997;337(7):447-452. [CrossRef]
16. Bertrand OF, Larose E, Rodés-Cabau J, et al. Incidence, predictors, and clinical impact of bleeding after transradial coronary stenting and maximal antiplatelet therapy. *Am Heart J*. 2009;157(1):164-169. [CrossRef]
17. Garg N, Umamaheswar KL, Kapoor A, et al. Incidence and predictors of forearm hematoma during the transradial approach for percutaneous coronary interventions. *Indian Heart J*. 2019;71(2):136-142. [CrossRef]
18. Helmy M, Tahaan E, El A, et al. Immediate Outcomes of trans radial approach versus anatomical snuff box access for coronary procedures. *Egypt J Hosp Med*. 2019;76(5):4099-4105.
19. Aoi S, Htun WW, Freeo S, et al. Distal transradial artery access in the anatomical snuffbox for coronary angiography as an alternative access site for faster hemostasis. *Catheter Cardiovasc Interv*. 2019;94(5):651-657. [CrossRef]
20. Montaser SS, Emara AM, Eletriby SA, Tawfeek AA. Transradial approach versus anatomical snuff box distal radial access for coronary procedures. *WJCD*. 2020;10(10):716-730. [CrossRef]
21. Koutouzis M, Kontopodis E, Tassopoulos A, et al. Distal versus traditional radial approach for coronary angiography. *Cardiovasc Revasc Med*. 2019;20(8):678-680. [CrossRef]
22. Yim YK, Lee C, Lee HJ, Park KS. Gender and measuring-position differences in the radial pulse of healthy individuals. *J Acupunct Meridian Stud*. 2014;7(6):324-330. [CrossRef]
23. Lee JW, Park SW, Son JW, Ahn SG, Lee SH. Real-world experience of the left distal transradial approach for coronary angiography and percutaneous coronary intervention: a prospective observational study (LeDRA). *EuroIntervention*. 2018;14(9):e995-e1003. [CrossRef]
24. Flores EA. Making the right move: use of the distal radial artery access in the hand for coronary angiography and percutaneous coronary interventions. *Cath Lab digest*. 2018;26(12):16-25.
25. Al-Azizi KM, Grewal V, Gobeil K, et al. The left distal transradial artery access for coronary angiography and intervention: a US experience. *Cardiovasc Revasc Med*. 2019;20(9):786-789. [CrossRef]

SUPPLEMENTARY MATERIAL

(S1) TECHNIQUE FOR VASCULAR ACCESS

After disinfection, the patient was wrapped with a sterile drape, and the right arm was safely positioned on the supportive armboard of the cathlab table. 1 ml of lidocaine was given subcutaneously at the puncture site.

For the dTRA approach, the patient's thumb was kept underneath the other 4 fingers, with slight abduction of the wrist, to make the distal radial artery (DRA) more superficial. The DRA was punctured at 30-45 degrees towards the point of maximum impulse with an Introcan® 20G needle in the anatomical snuffbox. Once the anterior wall of the radial artery (RA) had been successfully penetrated, a 0.035" guidewire was introduced into the RA.

For the cTRA approach, the RA was punctured with an Introcan 20G needle at an angle of 30-45 degrees, and a 0.035" guidewire was introduced using the Seldinger technique.

After a successful guidewire introduction, a Terumo Radifocus® Introducer II 6F or 5F radial hydrophilic sheath was passed over the guidewire. Subsequently, all patients were given 5000 IU of heparin to prevent thrombosis and 100 mcg of nitroglycerine to prevent spasm of the RA. A guidewire was then passed through the sheath, and further manipulation of a coronary catheter to selectively hook the coronary ostium was done similarly in the dTRA or cTRA groups.

Most commonly, a 5F TIG(Tiger) 110 cm - OPTITORQUE® Diagnostic Catheter (Terumo Corporation, Tokyo, Japan) was used for coronary angiography in both groups.