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Original article

Transulnar versus Transradial Approach for Percutaneous Coronary Procedures

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Abstract:

Background: Transradial access (TRA) for percutaneous coronary procedures has become a widely adopted approach, with proven safety and feasibility. However, the trans-ulnar access (TUA) remains a promising alternative. This study aimed to compare radial and ulnar approach for percutaneous coronary procedures as regard feasibility, safety, and incidence of complications. **Methods:** This cross sectional comparative study was conducted at the Cardiology Department Cath lab of Benha University Hospitals & National Heart Institute. One hundred patients were included, with 50 patients in the TRA group and 50 patients in the TUA group. Inclusion and exclusion criteria were defined. Various clinical and procedural parameters, including access techniques, were meticulously recorded. Hemostasis was achieved with external compression with the TR band. The study assessed immediate post-procedure complications, so after removal of the TR band and before hospital discharge, all patients were examined postprocedure for potential access-site complications, arterial occlusion was examined clinically and by reversed Barbeau test. **Results:** The study revealed no statistically significant differences between the TRA and TUA groups in terms of patient demographics, procedural success, duration, fluoroscopy time, and procedure type. There were also no significant disparities in the affected vessel and the number of deployed stents. However, there was a statistically significant increase in the percentage of spasm in patients with TRA (24%) compared to TUA (8%). Conversely, patients with TUA experienced a statistically significant increase in the incidence of hematoma (18%) compared to TRA (4%). **Conclusion:** TRA has emerged as the prevailing method of access for coronary procedures due to its comparable efficacy and elevated safety profile. Both TRA and TUA approaches were considered safe and feasible for percutaneous coronary procedures. On the other hand, in terms of minor complications, arterial spasm and occlusion were more commonly observed with the TRA, so the TUA remains a promising alternative & proved to be noninferior to the TRA for coronary procedures.

Keywords: Transradial; Transulnar; Percutaneous coronary procedures; Feasibility; Safety; Complications.

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Introduction

Diagnostic angiography and percutaneous coronary intervention (PCI) play crucial roles in diagnosing and treating various coronary artery diseases, from stable refractory angina to acute myocardial infarction. Advances in catheter design, interventional devices, and these procedures are now more effective and safer due to pharmacotherapy., allowing them to be performed on higher-risk patients with low complication rates (1).

Over the last decade, interventional cardiovascular medicine has undergone significant advancements, incorporating novel devices and methods for intracardiac and intravascular imaging, drug-eluting stents and percutaneous hemodynamic support, among other applications. These developments must be followed by cardiologists in order to deliver optimal patient care (2).

Diagnostic cardiac catheterization is indicated to confirm, exclude, or clarify suspected cardiac conditions. It is also used for patients undergoing corrective cardiac surgery and occasionally as a research procedure. The choice of vascular access is crucial, with the femoral approach being traditional, but the radial approach has grown fame due to its effectiveness and safety (3).

The transradial approach (TRA) for PCI is now widely accepted, proving its feasibility and safety for various cardiac conditions. TRA is associated with fewer access site bleeding complications, improved patient comfort, and shorter hospitalization duration. However, it has challenges such as a higher conversion rate to other approaches and the small and sometimes tortuous nature of the radial artery (4).

The brachial artery remains a viable access site for procedures requiring large sheaths, while the subclavian/axillary artery approach provides potential advantages, particularly in reducing sheath bending. However, it can be more prone to injury in certain patients due to its tortuosity (5).

When the TRA is contraindicated for a patient, the TUA provides a secure and efficacious alternative for coronary angiography and intervention. Particularly alluring are operators who possess prior experience with this technique, as well as situations involving radial artery variations or small-caliber arteries (6).

This study was intended to compare radial and ulnar approach for percutaneous coronary procedures as regard feasibility, safety, and incidence of complications.

Methodology

Patients:

This study was a cross sectional comparative study conducted at Cardiology Department Cath lab of Benha University Hospitals & National Heart Institute during the period between July 2021 and July 2022. Our study included 100 patients coming for CA or PCI, patients were distributed randomly for each vascular access, the patients were distributed as follow: 50 patients in the TRA group and 50 patients in the TUA group.

The study was approved by our local ethical committee (MD.2.1.2021), and a written informed consent was obtained from each patient.

Inclusion criteria were any patient who had no contraindications regarding radial or ulnar artery cannulation for percutaneous coronary procedures.

Exclusion criteria were CKD patients on regular hemodialysis, cardiogenic shock, history of CABG, severe dermomyoskeletal forearm deformities, serum creatinine level above 1.6 mg/dl, left ventricular ejection fraction ≤ 45 and abnormal Allen test result.

Methods:

Patient assessment encompassed comprehensive history-taking, including demographic and social characteristics, medication history, family medical history, and past medical background. Additionally, basic clinical examinations were conducted, and all patients underwent pre and post-procedure 12-lead ECG and echocardiography. Procedural success, duration, fluoroscopy time, and total procedural time were meticulously recorded. Immediate post-procedure assessment was conducted for potential complications, so after removal of the TR band and before hospital discharge, all patients were examined postprocedure for potential access-site complications, arterial occlusion was examined clinically and by reversed Barbeau test.

Preparation of Patients:

Patient positioning involved the use of an arm board extending from the catheterization table. Patients were placed on the table with their right arm extended on the arm board, palm upward, and the wrist extended using a gauze roll for support.

Radial Artery Puncture:

Two methodologies were utilized in order to puncture the radial artery. Using an open 21-gauge needle, the radial artery was punctured anteriorly, approximately 2 to 3 centimetres above the styloid process, where the artery is most palpable. When previous attempts failed, subsequent punctures were performed one centimetre proximal to the initial site. To improve visibility of blood return, shorter needles were favoured. The counter-puncture technique entailed inserting a needle sheathed in Teflon into the artery. Following the identification of blood in the needle hub, which signifies a puncture of the anterior wall, the needle was inserted into the posterior wall via the lumen. After achieving needle stabilization, the inner stylet was extracted, and the needle was withdrawn gradually into the arterial lumen. The guidewire was advanced when a continuous or pulsatile flow was observed [7].

Ulnar Artery Puncture:

The optimal location for puncturing the ulnar artery was between 0.5 and 3 cm proximal to the flexor crease, which is the skinfold along the axis of the artery with the strongest pulse. To avoid the ulnar nerve, Injection of the needle is at a 45° to 60° angle lengthways the vessel axis and from lateral to medial. Following infiltration of 100µg of nitroglycerin and a local anesthetic, arterial puncture was accomplished through palpation of the location where the pulse was at its peak. The needle was then threaded with a 0.021-inch hydrophilic guidewire using the Seldinger technique. Following the withdrawal of the needle, a 6 French hydrophilic sheath was inserted into the guidewire (Figure, 1). Heparin and intra-arterial vasodilators (nitroglycerin and verapamil) were administered, in addition to cardiac catheterization. Following catheterization, the sheath was extracted, and a compressive dressing was utilized to achieve hemostasis [8].

Ulnar Artery Puncture Variations: When ulnar artery pulsations are weak but palpable at the distal wrist, it is considered safe to indentify the ulnar artery further distally, at the level of skinfolds over the carpal bones. This approach decreases the likelihood of postprocedural hematoma. [9] It is also possible to puncture the ulnar artery at a greater elevation, reaching the midforearm, if percussions are perceived. This strategy could prove beneficial for seasoned operators but requires caution due to the proximity of the ulnar nerve, especially when exchanging or upgrading sheaths of different sizes [10].

Adjunctive Pharmacologic Treatment: To mitigate the risk of arterial spasm, a spasmolytic cocktail and heparin were administered, which included various combinations such as nitroglycerin and verapamil [9].

Vascular Access Site Hemostasis: After performing percutaneous intervention, the arterial access sheath was extracted, and hemostasis was accomplished by applying compressive band compression in the ulnar or radial directions [9].

Primary Clinical Outcomes: The primary study endpoint was a consisting of bleeding and access site complications, along with Major Adverse Cardiovascular

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and Cerebrovascular Events (MACCE). Bleeding was classified as non-access and access site bleeding, with specific definitions for TIMI major and minor bleeds. Access site bleeding was categorized as small or large hematoma. Additional complications associated with vascular access sites comprised arteriovenous fistula, pseudoaneurysm, arterial spasm, and arterial occlusion, in addition to surgical repair or intervention. Nonfatal myocardial infarction, stroke, acute heart failure, or death constituted MACCE [9].

Secondary Procedural Outcomes: Secondary outcomes encompassed procedural success to measure the incidence of crossover, recorded fluoroscopy time in minutes, and recorded procedural time in minutes [9].

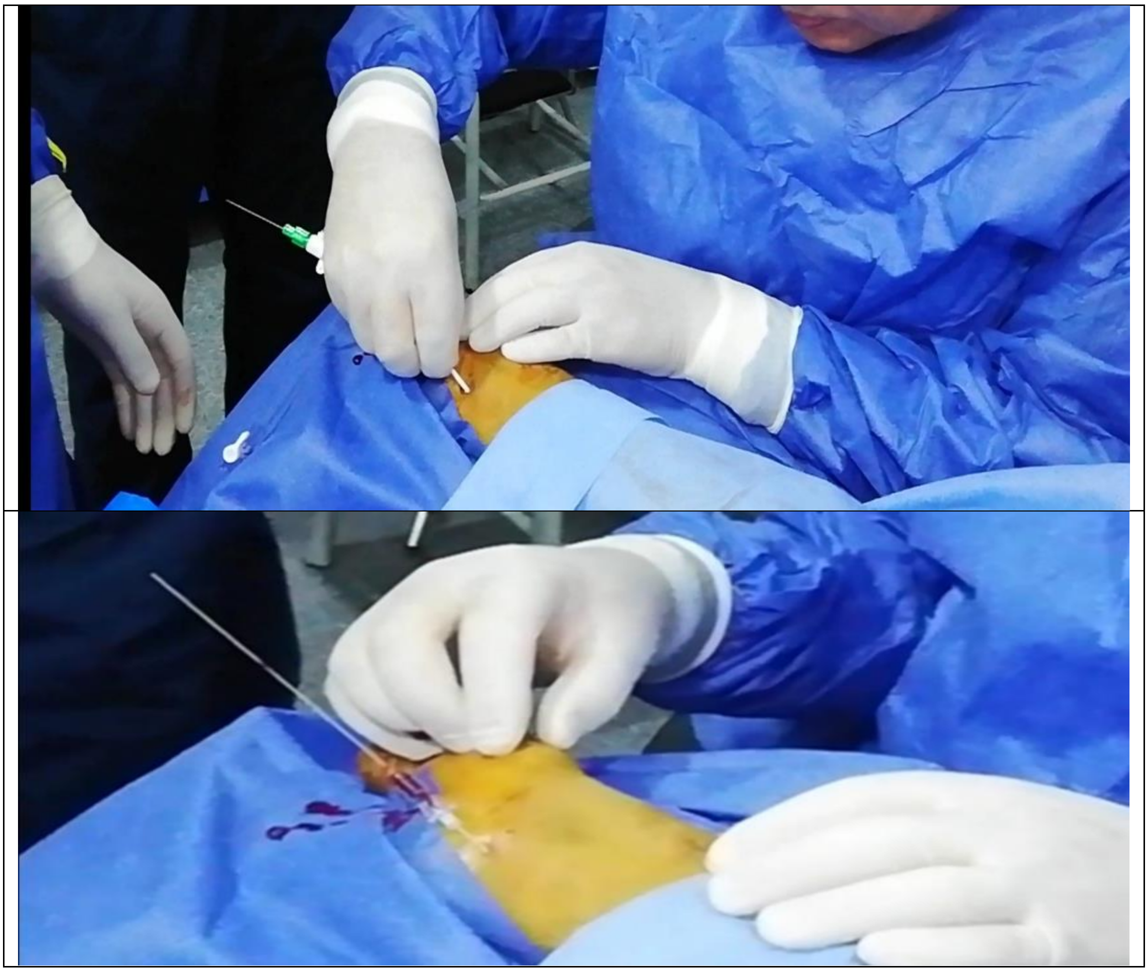

Figure 1: Ulnar artery puncture and sheath insertion.

Statistical analysis:

The data underwent scrutiny using Statistical Program for Social Science (SPSS) version 24. For the presentation of qualitative data, the study employed frequency and percentage as the chosen metrics. When it came to quantitative data, the approach varied depending on the data's distribution. Normally distributed data was articulated as mean ± standard deviation (SD), serving as a measure of the central tendency and the dispersion, respectively. In cases where the data did not conform to a normal distribution, median with inter-quartile range (IQR) was used, signifying the middle value and the statistical spread. Additionally, several statistical tests were conducted, each tailored to the nature of the data: The Mann Whitney U test (MW) for

comparing two groups whose data are not normally distributed, the Independent Sample T test (T) for comparing two groups whose data are normally distributed, and the Chi-square test for comparing non-parametric data. The outcomes were assessed using the probability measure (*p*-value). A significance level was set at 0.05, a *p*-value below 0.001 indicated high significance, and a *p*-value above 0.05 indicated insignificance.
Approval code: MD.2.1.2021

Results

As regard demographic data & risk factors there were no statistically significant differences between both groups as follow: Age (p = 0.358), sex (p = 0.806), smoking (p = 0.260), DM (p = 0.841), HTN (p = 0.683), and dyslipidaemia (p = 0.832) (Table, 1).

Also, there were no statistically significant differences between both groups as regard catheterization data, in terms of the number of puncture trials (p = 0.346), access time (p = 0.552), fluoroscopy time (p = 0.219), procedure time (p = 0.059), procedure type (p = 1.0), the affected vessel (p = 0.244), and number of deployed stents (p = 0.370). Specifically, the proportion of successful access from the first, second, or third trial did not significantly differ between the TRA and TUA groups, nor did access time, fluoroscopy time, or procedure time. The distribution of patients undergoing PCI versus coronary angiography (CA) was also similar in both groups. Additionally, the affected vessels and the number of deployed stents showed no statistically significant differences between TRA and TUA patients (Table, 1).

No significant difference (p = 0.936) between TRA patients and TUA patients as regard LVEF. In patients with radial access, median LVEF was 56.5% with IQR of 50 -62% while in patients with TUA median LVEF was 57% with IQR of 50 - 61.25% (Figure, 2).

As regard complications, an increase that was statistically significant occurred in the percentage of spasm in patients with TRA (12 patients, 24%) compared to patients with TUA (4 patients, 8%) with a p -value of 0.029. Additionally, a statistically significant increase in the percentage of hematoma was detected in patients with TUA (9 patients, 18%) compared to patients with TRA (2 patients, 4%) with a p -value of 0.025. Patients with TUA also experienced statistically significant incidence of discomfort (11 patients, 22%) compared to those with TRA (3 patients, 6%) with a p -value of 0.021. No significant differences were found in terms of occlusion (p = 0.169) or crossover (p = 0.538). Moreover, no significant disparities were observed in the causes of crossover between patients with TRA and TUA (p -value = 0.162), with various factors contributing to this outcome in both groups (Table, 2).

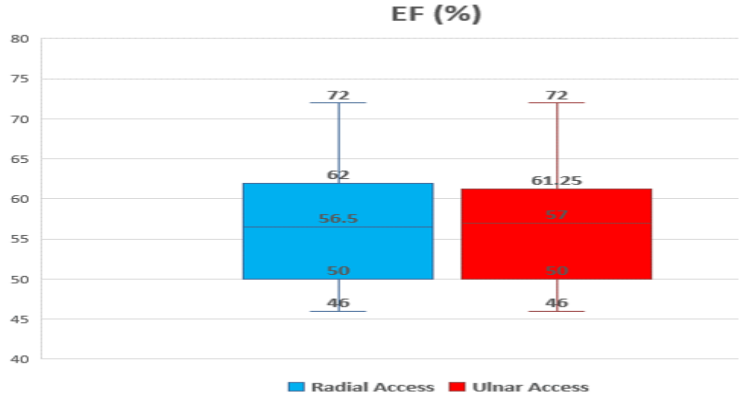

Figure 2: Comparison between radial & ulnar access groups regarding the LVEF.

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Table 1: Demographic data and catheterization data of the whole study population:

		Access Radial (N = 50)		Ulnar (N = 50)		Stat. test	*p* -value
Demographic data							
Age (years)	Mean	57.5		56.3		T = 0.92	0.358 NS
	±SD	7.4		5.6			
Sex	Male	40	80%	39	78%	X^2 = 0.06	0.806 NS
	Female	10	20%	11	22%		
Risk factors	Smoking	39	78%	34	68%	X^2 = 1.26	0.260 NS
	DM	25	50%	26	52%	X^2 = 0.04	0.841 NS
	HTN	31	62%	29	58%	X^2 = 0.16	0.683 NS
	Dyslipidemia	34	68%	33	66%	X^2 = 0.04	0.832 NS
Catheterization data							
No. of puncture trials	Failed	0	0%	3	6%	X^2 = 3.3	0.346 NS
	1st trial	19	38%	20	40%		
	2nd trial	30	60%	26	52%		
	3rd trial	1	2%	1	2%		
Access time (min)	Median	5.2		5.2		MW = 1164	0.552 NS
	IQR	4.9 – 5.5		5 – 5.5			
Fluoroscopy time (min)	Median	8.65		8.25		MW = 1072	0.219 NS
	IQR	5.6 – 12.6		5 – 12.1			
Procedure time (min)	Median	30		26		MW = 976	0.059 NS
	IQR	22.5 - 37		20.3 – 36			
Procedure type	PCI	25	50%	25	50%	X^2 = 0.0	1.0 NS
	CA	25	50%	25	50%		
Affected vessel	LAD	12	48%	8	32%	X^2 =5.4	0.244 NS
	LCX	4	16%	6	24%		
	RCA	7	28%	9	36%		
	OM	2	8%	0	0%		
	Diagonal	0	0%	2	8%		
Number of deployed stents	1 stent	15	60%	18	72%	X^2 = 0.8	0.370 NS
	2 stents	10	40%	7	28%		

T: independent sample T test, X2: Chi-square test. MW: Mann Whitney U test, NS: $p > 0.05$ is considered non-significant.

Table 2: Distribution of complications among radial and ulnar access groups.

		Access Radial (N = 50)		Ulnar (N = 50)		Stat. test	*p* -value
complications	Spasm	12	24%	4	8%	X^2 = 4.7	0.029 S
	Hematoma	2	4%	9	18%	X^2 = 5.0	0.025 S
	Discomfort	3	6%	11	22%	X^2 = 5.3	0.021 S
	Occlusion	4	8%	1	2%	X^2 = 1.89	0.169 NS
	Crossover	5	10%	7	14%	X^2 = 0.37	0.538 NS
Cross over causes	Spasm	2	40%	2	28.6%	X^2 = 5.1	0.162 NS
	Tortuosity	2	40%	0	0%		
	Hematoma	1	20%	2	28.6%		
	Failure to puncture	0	0%	3	42.9%		

S: $p < 0.05$ is considered significant, X^2: Chi-square test, NS: $p > 0.05$ is considered non-significant.

Table 3: Comparison between right and left access groups regarding the demographic & catheterization data.

		Access				Stat. test	*p* -value
		Right (N = 50)		Left (N = 50)			
Demographic data							
Age (years)	**Mean**	56.4		57.4		T = 0.71	0.479 NS
	±SD	7.7		5.1			
Sex	**Male**	38	76%	41	82%	$X^2 = 0.54$	0.461 NS
	Female	12	24%	9	18%		
Risk factors	**Smoking**	35	70%	38	76%	$X^2 = 0.45$	0.499 NS
	DM	28	56%	23	46%	$X^2 = 1.0$	0.317 NS
	HTN	30	60%	30	60%	$X^2 = 0.0$	1.0 NS
	Dyslipidemia	34	68%	33	66%	$X^2 = 0.04$	0.832 NS
Catheterization data							
No. of trials	Failed	1	2%	2	4%	$X^2 = 1.61$	0.655 NS
	1st trial	17	34%	22	44%		
	2nd trial	31	62%	25	50%		
	3rd trial	1	2%	1	2%		
Access time (min)	Median	5.2		5.1		MW = 1201.5	0.737 NS
	IQR	4.9 – 5.5		4.9 – 5.5			
Fluoroscopy time (min)	Median	10		6.75		MW = 1192.5	0.691 NS
	IQR	5.4 - 13		5.5 – 12.1			
Procedure time (min)	Median	32.5		26.7		MW = 927.5	0.026 S
	IQR	22 – 37.25		21 - 34			
Procedure type	PCI	26	52%	24	48%	$X^2 = 0.16$	0.689 NS
	CA	24	48%	26	52%		
Affected vessel	LAD	10	38.5%	10	41.7%	$X^2 = 1.77$	0.777 NS
	LCX	7	26.9%	3	12.5%		
	RCA	7	26.9%	9	37.5%		
	OM	1	3.8%	1	4.2%		
	Diagonal	1	3.8%	1	4.2%		
Stents	1 stent	17	65.4%	16	66.7%	$X^2 = 0.009$	0.924 NS
	2 stents	9	34.6%	8	33.3%		

MW: Mann Whitney U test, S: $p < 0.05$ is considered significant, T: independent sample T test, X^2: Chi-square test, NS: $p > 0.05$ is considered non-significant, IQR: Inter-Quartile Range, SD: Standard Deviation, DM: Diabetes Mellitus, HTN: Hypertension, PCI: Percutaneous Coronary Intervention, CA: Coronary Angiography, LAD: Left Anterior Descending artery, LCX: Left Circumflex artery, RCA: Right Coronary Artery, OM: Obtuse Marginal artery.

In Table 3, there were no statistically significant differences detected between patients with right access and patients with left access across several parameters. This included age, where the mean age was 56.4 ± 7.7 years for right access and 57.4 ± 5.1 years for left access, with a *p* -value of 0.479. Similarly, there were no significant differences in sex distribution, with 38 males (76%) and 12 females (24%) in the right access group, and 41 males (82%) and 9 females (18%) in the left access group, yielding a p-value of 0.461. Other factors, such as smoking, diabetes (DM), hypertension (HTN), and dyslipidaemia, showed no statistically significant differences between right and left access groups, with *p* -values of 0.499, 0.317, 1.0, and 0.832, respectively. Patients did not differ statistically significantly ($p > 0.05$) with right access and patients with left access for several catheterization data parameters (the number of puncture trials, access time, fluoroscopy time, procedure type, the affected vessel , and the number of deployed stents). Notably, there was a statistically significant reduction in procedure time in patients with left access (median = 26.7 min, IQR = 21 - 34 min) when compared to patients with right access (median = 32.5 min, IQR = 22 – 37.25 min) with (*p*-value of 0.026) (Table, 3).

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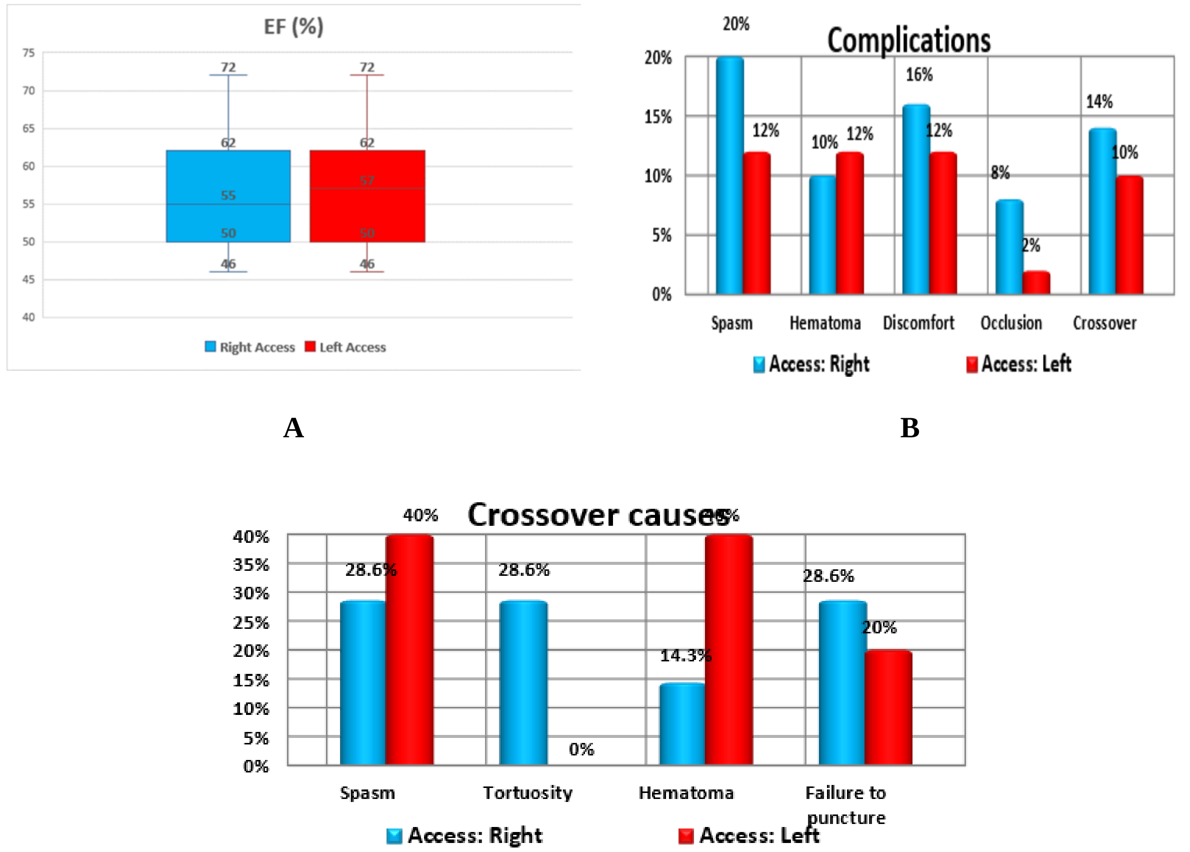
No statistically significant difference (*p* -value = 0.685) between patients of right access and patients of left access as regard LVEF. In patients with right access, median EF was 55% with IQR of 50 -62% while in patients with left access median EF was 57% with IQR of 50 - 62% (Figure, 3A).
As regard complications, there were no statistically significant differences (*p* >0.05) between patients with right access and patients with left access in terms of spasm, hematoma, discomfort, occlusion, and crossover (Figure, 3B). Furthermore, there were no statistically significant disparities in the causes of crossover between right and left access patients, with various factors contributing to this outcome in both groups (Figure, 3C).



A B

C

Figure 3: Comparison between right & left access groups regarding (A) the LVEF, (B) the complications and (C) the causes of crossover.

Discussion

Regarding LVEF in the current study, our results were in line with the previous studies[11] which included 100 patients who presented with chronic coronary syndrome and were referred, if necessary, for PCI and coronary angiography. The patients were categorized into two distinct groups: group A consisted of fifty individuals who underwent TRA coronary angiography; and group B comprised fifty individuals who underwent TUA coronary angiography. There were no statistically significant differences observed between the two groups by the researchers.
Regarding catheterization data, our results were in agreement with a recent study [12] that reported that there was no significant difference in the total procedural time,

fluoroscopy time, or number of puncture attempts between the two groups. Our results were supported by the Egyptian recent study [11] as there was no significant distinction observed between the two groups with respect to procedural parameters, including the average access time, average fluoroscopy time, and average procedural time. Also, other researchers [13] in their study reported that the average procedure time for CA was 22.4 ± 2.5 minutes and for PCI in the ulnar group it was 37.8 ± 3.6 minutes. In contrast, it was 20.7 ± 2.7 for CA and 35.2 ± 4.9 for PCI in the radial group. The duration of the CA procedure was notably longer in the ulnar group compared to the radial group. However, there was no statistically significant difference in the PCI procedure time between the two groups. In their research, the average duration of the procedure was 26.4 ± 7.4 minutes for the ulnar group and 25.9 ± 7.7 minutes for the radial group. There was no statistically significant difference observed in the mean procedure time between the two groups.

While, in the previous study 2020 [8]**,** the mean fluoroscopy time in the ulnar group was 5.6 ± 1.9 min for CA and 12.4 ± 2.6 min for PCI, whereas in the radial group it was 5.3 ± 2.1 min for CA and 11.9 ± 2.3 min for PCI. However, none of these differences reached statistical significance ($p > 0.05$). The ulnar group exhibited significantly longer procedure times for CA and PCI than the radial group (p = 0.011 and 0.034, respectively). On mean, the ulnar group required 22.6 ± 2.6 min for CA and 36.1 ± 4.1 min for PCI, whereas the radial group required 21.2 ± 2.9 min for PCI and 34.2 ± 4.8 min for PCI. In a study done in the same year [14]**,** the angiographic and procedural data exhibited in the two groups did not differ significantly, with the exception of vascular access achievement time (p < 0.001). In contrary to our results, a study found that TUA required a mean procedure time of 21 ± 11 minutes, which was marginally longer than the 20 ± 8 minutes required for TRA [15].

The difference between these studies and ours may be explained by different sample size and different co-morbidities.

In the study in our hands, regarding complications; our results were supported by others [15] as they stated that the incidence of spasm was considerably greater with the TRA (12.6%) than with the TUA (1.9%), consistent with findings from other research, for instance the study carried out by Hahalis et al [16]. Minor complications did not differ significantly, except for arterial occlusion (9.0% vs 1.0%) and artery spasm (12.6% vs 1.9%), in trans radial & trans ulnar approaches, respectively (p < 0.05). This may be due to the radial artery's diminutive size and tortuous nature, both of which render it susceptible to spasm. Arterial spasm can be reduced by flushing with a cocktail containing nitrate and/or verapamil, handling the wire and catheter with care, and reducing puncture time. The reduced incidence of ulnar artery occlusion can be attributed to two factors: the greater diameter of the ulnar artery and its deep anatomical position, which hindered complete occlusion of the artery during hemostasis when compared to the radial approach. In a previous study [11]**,** there was a significant difference as regards hematoma and discomfort symptoms with a higher incidence in group B (trans ulnar group) and artery occlusion with a higher incidence in group A (trans radial group) with no significant difference between the two groups as regards the incidence of arterial spasm and crossover.

The angiographic success of vascular access was reported to be achieved in 95 (95%) vs. 75 (75%) in the TRA vs. TUA groups, respectively (p < 0.001) [14]. In the TRA and TUA groups, crossover was required in 5 (5%) cases and 25 (25%) cases, respectively (p < 0.0001). In the TRA group, the artery was not punctured successfully in 2 (2%) cases, and in 1 (1%)

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case, the introduction of the vascular sheath was not successful, although the vessel was punctured successfully. In the remaining 2 cases in the TRA group, crossover was necessary because of the difficulty in continuing the procedure after a successful introduction of the vascular sheath. In 16 (16%) cases in the TUA group, the artery was not punctured successfully, and in another 8 (8%) cases, the vascular sheath was not successfully introduced. Moreover, crossover was necessary after the insertion of the diagnostic catheter in 1 case. Because of crossover events between the two groups, ultimately, TRA was used in 120 (60%), TUA in 77 (38%), and the brachial artery in 3 (2%) patients. No differences were observed in terms of the incidence of early and late complications between the groups [(14)].

However, in meta-analysis conducted by Dahal et al [(17)], five RCTs involving 2,744 total patients were included in the meta-analysis. TUA compared with TRA had similar risks of MACE [risk ratio (RR): 0.87; 95% confidence interval (CI): 0.56–1.36; $p = 0.54$] and access-related complications [RR: 0.92 (0.67–1.27); $p = 0.62$]. Higher rates of access crossover [RR: 2.31 (1.07–4.98); $p = 0.003$] were noted with TUA.

In the study of Shafiq et al [(8)], there were no statistically significant differences between both groups regarding all types of complications ($p > 0.05$), three cases in the ulnar group (7.5%) showed ulnar artery occlusion after the procedure documented with post procedural duplex compared with two cases in the radial group (2.5%) ($p = 0.647$). While regarding arterial spasm, their study showed that four cases in the radial group (5%) developed persistent spasm compared with one case of transient spasm in the ulnar group (2.5%) with no statistically significant difference ($p = 0.343$). Minor hematoma occurred in the same percentage of 2.5%: 2 cases in the radial group and 1 case in the ulnar group ($p = 0.999$).

Similarly, it was stated that large hematoma occurred in 1 patient in each group ($p > 0.05$). Crossover occurred in two patients in each group ($p > 0.05$). Spasm happened in 6.48% of TUA population compared to 8.18% of TRA ($p > 0.05$) population. No statistically significant difference ($p > 0.05$) was found in arterial occlusion rates between TUA (5.56%) and TRA (6.36%) arms. One patient in TUA arm had transient ulnar nerve paresthesia with no residual manifestation at the time of discharge suggesting that damage to ulnar nerve is uncommon and a reversible adverse event of UA cannulation [(12)].

In meta-analysis held by Faisaluddin et al [(6)], a very recent study, a total of 4,796 patients in 8 studies were included in this analysis (TUA = 2,420 [50.4%] and TRA = 2,376 [49.6%]). TUA had higher crossover rate (OR 1.80, 95% confidence interval 1.04 to 3.11, I2 = 75.37%, $p = 0.04$) than did TRA. There was no difference in arterial spasm and large hematoma between both cohorts. Furthermore, there was no difference in procedural time, fluoroscopy time between TUA and TRA.

Conclusion

TRA has emerged as the prevailing method of access for coronary procedures due to its comparable efficacy and elevated safety profile. Both TRA and TUA approaches were considered safe and feasible for percutaneous coronary procedures. On the other hand, in terms of minor complications, arterial spasm and occlusion were more commonly observed with the TRA, so the TUA remains a promising alternative & proved to be noninferior to the TRA for coronary procedures.

Conflict of interest

None of the contributors declared any conflict of interest.

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