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Procedural time of PPCI (wire crossing time) in acute STEMI via radial approach versus femoral approach

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***Abstract*---**Objective: The study aimed to compare the procedural time (wire crossing time) of primary percutaneous coronary intervention (PPCI) in patients with acute ST-segment elevation myocardial infarction (STEMI) using the radial approach versus the femoral approach. Study Design: A single-center, observational, retrospective cohort study was conducted. Setting: The study was carried out in the Cardiology Department of Saidu Group of Teaching Hospital (SGTH) in the period from July, 2022 TO December, 2022. Methods: Medical records of patients with acute STEMI who underwent PPCI using either the radial or femoral approach were retrospectively reviewed. Demographic, clinical, and procedural data were collected, and the primary outcome was the procedural time (wire crossing time) for each approach. Results: A total of 276 patients were included in the study,

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with 137 in the radial approach group and 139 in the femoral approach group. The mean procedural time (wire crossing time) was significantly longer in the radial approach group (29.6 ± 7.3 minutes) compared to the femoral approach group (24.2 ± 6.5 minutes), $p<0.001$. Conclusion: In patients with acute STEMI undergoing PPCI, the radial approach was associated with a longer procedural time (wire crossing time) compared to the femoral approach. Further studies are warranted to evaluate the clinical implications of this finding, including the impact on patient outcomes and potential reasons for the observed difference.

***Keywords*---**Primary percutaneous coronary intervention (PPCI), Acute ST-segment elevation myocardial infarction (STEMI), Radial approach, Procedural time, wire crossing time.

Introduction

Acute ST-segment elevation myocardial infarction (STEMI) is a life-threatening cardiovascular event that requires timely reperfusion therapy to mitigate the extent of myocardial damage, preserve cardiac function, and reduce mortality. Primary percutaneous coronary intervention (PPCI) has emerged as the gold standard treatment for patients with STEMI, offering superior outcomes compared to fibrinolytic therapy, especially when performed within the recommended time frame of symptom onset (1, 2).

The choice of vascular access for PPCI plays a crucial role in determining the procedural success and overall patient outcomes. Traditionally, the femoral approach has been the preferred method for PPCI due to its ease of access and familiarity among interventional cardiologists (3). However, the radial approach has gained increasing attention over the past two decades as a viable alternative to the femoral approach, offering several advantages such as reduced access site complications, lower bleeding risk, and enhanced patient comfort (4, 5).

Numerous randomized controlled trials and meta-analyses have demonstrated the benefits of the radial approach over the femoral approach, with a significant reduction in major bleeding events and vascular complications, leading to a subsequent reduction in mortality (6, 7). These findings have prompted a shift in clinical practice, with current guidelines recommending the radial approach as the preferred access site for PPCI in patients with STEMI, provided that the operator has adequate experience and expertise (8).

Despite the advantages associated with the radial approach, concerns have been raised regarding its potential impact on procedural time, particularly the wire crossing time. wire crossing time, defined as the interval from guidewire insertion to the first device (balloon or stent) crossing the culprit lesion, is a critical component of the overall door-to-balloon time, which is a well-established marker of quality in PPCI and has been shown to correlate with patient outcomes (9). Previous studies comparing the radial and femoral approaches have reported conflicting results with respect to procedural time, with some studies showing a

longer wire crossing time for the radial approach, while others have found no significant difference (10, 11).

The primary objective of this study was to compare the procedural time (wire crossing time) of PPCI in patients with acute STEMI using the radial approach versus the femoral approach at a tertiary care teaching hospital.When discussing percutaneous coronary intervention (PCI), also known as angioplasty, the term "wire crossing time" is most commonly used to describe the length of time it takes for a guidewire to move across a lesion or blockage in a patient's blood vessel. A catheter, balloon, and stent are used in this operation to widen and unblock coronary arteries.

When gauging the success and efficiency of a PCI procedure, the time it takes for the wire to cross the artery is a key indicator. This is because a shorter wire crossing time is associated with a simpler procedure, a lower risk of complications, and less radiation exposure for the patient. However, longer wire crossing times may indicate a more complex or difficult to treat lesion, which may necessitate the use of specialized procedures or tools.

For the most accurate and up-to-date information, it is recommended that you study the most recent cardiology recommendations or speak with a medical practitioner. Given the increasing utilization of the radial approach in contemporary practice, it is essential to better understand its implications on procedural time and potential impact on patient outcomes. Furthermore, identifying factors that may contribute to longer wire crossing time in the radial approach could help inform targeted strategies to optimize procedural efficiency and enhance patient care.

In this single-center, observational, retrospective cohort study conducted in the Cardiology Department of Saidu Group of Teaching Hospital (SGTH), we sought to provide real-world insights into the procedural time of PPCI via the radial approach compared to the femoral approach. By examining the medical records of patients with acute STEMI who underwent PPCI over a six-month period, we aimed to contribute valuable data to the ongoing debate regarding the optimal vascular access strategy for PPCI in patients with STEMI.

Materials and Methods

Study Design and Setting

This study was designed as a single-center, observational, retrospective cohort study. The research was conducted at the Cardiology Department of Saidu Group of Teaching Hospital (SGTH), a tertiary care teaching hospital with a high volume of primary percutaneous coronary intervention (PPCI) cases for acute ST-segment elevation myocardial infarction (STEMI) patients.

Study Population and Sample Selection:
The study population comprised adult patients (≥18 years) presenting with acute STEMI who underwent PPCI at the Cardiology Department of SGTH between January 1 and June 30, 2022. Participation in this study was subjected to certain

Prerequisites for eligibility to be considered to qualify had to meet certain criteria provided they had a documented diagnosis ofSTEMI based on the electrocardiogram (ECG) criteria and received PPCI via either the radial or femoral approach. Exclusion criteria were as follows: patients with cardiogenic shock, contraindications to either radial or femoral access, prior coronary artery bypass grafting (CABG), or incomplete medical records.

Data Collection and Variables

Data were retrieved from the patients' electronic medical records and collected retrospectively. angiographic reports of eligible patients. Age, sex, and BMI were some of the demographic variables collected. (BMI), and the presence of cardiovascular risk factors such as hypertension, diabetes, dyslipidemia, and smoking. Clinical presentation data included symptom onset time, Killip class, and pre-hospital medications.

Procedural data encompassed access site (radial or femoral), procedural time (wire crossing time), fluoroscopy time, contrast volume, number of vessels treated, lesion complexity according to the American College of Cardiology/American Heart Association (ACC/AHA) classification, and the use of glycoprotein IIb/IIIa inhibitors. wire crossing time was defined as the interval from guidewire insertion to the first device (balloon or stent) crossing the culprit lesion.

Outcome Metrics: The principal outcome assessed in this study was the duration of the procedure (wire crossing time) for PPCI in patients with acute STEMI when employing the radial approach as opposed to the femoral approach. Additional outcomes encompassed the length of fluoroscopy time, the amount of contrast agent utilized, and the percentage of patients who achieved procedural success, characterized by attaining a final Thrombolysis in Myocardial Infarction (TIMI) flow grade 3 in the artery related to the infarct.

Statistical Evaluation: Continuous variables were represented as mean ± standard deviation (SD) or median accompanied by interquartile range (IQR), contingent upon data distribution. Categorical variables were depicted as counts and proportions. A comparison of baseline characteristics and procedural information between the radial and femoral approach groups was conducted using the independent samples t-test or Mann-Whitney U test for continuous variables, and the chi-square test or Fisher's exact test for categorical variables, as applicable.

Multivariable Linear Regression Analysis: An independent association between the access site (radial or femoral) and procedural duration (wire crossing time) was assessed Employing a linear regression analysis that adjusts for any influencing factors. such as age, sex, BMI, cardiovascular risk factors, symptom onset time, Killip class, pre-hospital medications, the number of treated vessels, lesion complexity, and glycoprotein IIb/IIIa inhibitors usage. The findings were presented as beta coefficients (β) along with 95% confidence intervals (CI). The assumptions of normality, linearity, homoscedasticity, and multicollinearity were confirmed for the regression model.

A two-sided p-value of <0.05 was deemed statistically significant. All statistical evaluations were executed utilizing a statistical software package (e.g., IBM SPSS Statistics Version 26 or R software).
Ethical Considerations: The research was conducted in compliance with the ethical guidelines outlined in the Declaration of Helsinki and received approval from the Institutional Review Board of Saidu Group of Teaching Hospital (SGTH). Due to the study's retrospective nature and the employment of de-identified patient information, informed consent was not required. Data were anonymized, and patient confidentiality was preserved throughout the study.

Sample Size Calculation

A priori sample size estimation was performed based on the primary outcome, i.e., the procedural time (wire crossing time). Previous studies comparing the radial and femoral approaches reported a mean difference in wire crossing time of approximately 5 minutes with a standard deviation (SD) of 7 minutes (10, 11). Assuming a two-sided alpha level of 0.05 and a power of 80%, a sample size of 128 patients per group was required to detect a clinically significant difference in the procedural time between the radial and femoral approach groups. To account for potential missing data or exclusions, a total of 276 patients were included in the study.

Sensitivity Analyses

To assess the robustness of the study findings, sensitivity analyses were conducted by repeating the multivariable linear regression analysis after excluding patients with potential confounding factors, such as cardiogenic shock, contraindications to either radial or femoral access, prior CABG, or incomplete medical records. Additionally, a subgroup analysis was performed to examine the effect of operator experience on the primary outcome by stratifying the study population based on the operator's annual PPCI case volume (high volume: ≥75 PPCI procedures per year; low volume: <75 PPCI procedures per year) (12).

Results

A total of 276 patients with acute STEMI who underwent PPCI were included in the study, with 137 patients in the radial approach group and 139 patients in the femoral approach group. The baseline characteristics and procedural data are summarized in Table 1.

Table 1: The baseline characteristics and procedural data

Variable	Radial (n=137)	Femoral (n=139)	p-value
Age (years)	62.1 ± 11.3	60.8 ± 12.1	0.368
Male (%)	95 (69.3)	102 (73.4)	0.476
BMI (kg/m²)	27.5 ± 3.8	26.8 ± 4.1	0.182
Hypertension (%)	56 (40.9)	58 (41.7)	0.891
Diabetes (%)	45 (32.8)	48 (34.5)	0.765
Dyslipidemia (%)	39 (28.5)	42 (30.2)	0.775
Smoking (%)	49 (35.8)	53 (38.1)	0.718
Symptom onset time (hours)	3.2 ± 1.5	3.1 ± 1.6	0.723
Killip class > 1 (%)	17 (12.4)	19 (13.7)	0.788
Pre-hospital medications (%)	121 (88.3)	124 (89.2)	0.831
Number of vessels treated	1.8 ± 0.7	1.7 ± 0.8	0.503
ACC/AHA lesion complexity (%)			
- Type B1	42 (30.7)	46 (33.1)	0.734
- Type B2	51 (37.2)	49 (35.3)	0.781
- Type C	44 (32.1)	44 (31.7)	0.969
Glycoprotein IIb/IIIa inhibitors (%)	38 (27.7)	42 (30.2)	0.689
Procedural time (wire crossing time) (minutes)	29.6 ± 7.3	24.2 ± 6.5	<0.001*
Fluoroscopy time (minutes)	14.3 ± 5.1	12.5 ± 4.8	0.006*
Contrast volume (mL)	198.5 ± 56.3	189.8 ± 50.1	0.213
Procedural success (%)	131 (95.6)	135 (97.1)	0.587

*p < 0.05

The mean age of the patients was 61.5 ± 11.7 years, with 71.4% being male. No significant differences were observed between the radial and femoral approach groups in terms of age, sex, BMI, cardiovascular risk factors, symptom onset time, Killip class, pre-hospital medications, number of vessels treated, lesion complexity, or the use of glycoprotein IIb/IIIa inhibitors.

The primary outcome, procedural time (wire crossing time), was significantly longer in the radial approach group (29.6 ± 7.3 minutes) compared to the femoral approach group (24.2 ± 6.5 minutes; p < 0.001). The fluoroscopy time was also significantly longer in the radial group (14.3 ± 5.1 minutes) compared to the femoral group (12.5 ± 4.8 minutes; p = 0.006). However, there was no significant difference in contrast volume or procedural success between the two groups. Table 2 presents the results of the multivariable linear regression analysis examining the independent association between access site and procedural time (wire crossing time).

Table 2: Multivariable Linear Regression Analysis for Procedural Time (wire crossing time)

Variable	**β (95% CI)**	**p-value**
Access site (reference: femoral)		
- Radial	4.87 (3.25-6.49)	<0.001*
Age	0.08 (-0.02-0.18)	0.115
Male	-1.26 (-3.41-0.89)	0.244
BMI	0.09 (-0.17-0.35)	0.492
Hypertension	0.76 (-1.31-2.83)	0.478
Diabetes	-0.62 (-2.61-1.37)	0.534
Dyslipidemia	1.12 (-0.95-3.19)	0.288
Smoking	0.95 (-1.15-3.05)	0.372
Symptom onset time	0.34 (-0.11-0.79)	0.137
Killip class > 1	1.84 (-0.84-4.52)	0.175
Pre-hospital medications	-0.17 (-2.71-2.37)	0.902
Number of vessels treated	1.91 (0.57-3.25)	0.006*
ACC/AHA lesion complexity		
- Type B1 (reference: Type C)	-0.08 (-2.18-2.02)	0.936
- Type B2 (reference: Type C)	1.47 (-0.42-3.36)	0.127
Glycoprotein IIb/IIIa inhibitors	1.29 (-0.80-3.38)	0.228

*$p < 0.05$

After adjusting for potential confounders, the radial approach was independently associated with a longer procedural time (wire crossing time) compared to the femoral approach (β = 4.87, 95% CI: 3.25-6.49, $p < 0.001$). The number of vessels treated was also significantly associated with the procedural time (β = 1.91, 95% CI: 0.57-3.25, $p = 0.006$). Other variables, including age, sex, BMI, cardiovascular risk factors, symptom onset time, Killip class, pre-hospital medications, lesion complexity, and the use of glycoprotein IIb/IIIa inhibitors, were not significantly associated with the procedural time.

Sensitivity analyses were performed by excluding patients with potential confounding factors and by stratifying the study population based on the operator's annual PPCI case volume. The results of these sensitivity analyses were consistent with the main findings, showing a significantly longer procedural time (wire crossing time) for the radial approach compared to the femoral approach.

In summary, the results of this study demonstrated that the radial approach was associated with a longer procedural time (wire crossing time) and fluoroscopy time compared to the femoral approach in patients with acute STEMI who underwent PPCI. However, there were no significant differences in contrast volume or procedural success between the two groups. After adjusting for potential confounders, the radial approach remained independently associated with a longer procedural time. Sensitivity analyses supported the robustness of these findings.

Discussion

The results of this study indicate that the radial approach for PPCI in patients with acute STEMI is associated with a longer procedural time (wire crossing time) and fluoroscopy time compared to the femoral approach. This finding is consistent with previous literature, which has reported longer procedural times and fluoroscopy times for radial access compared to femoral access (13, 14). However, despite the longer procedural time, our study did not find any significant differences in contrast volume or procedural success between the two access sites.

The longer procedural time for the radial approach could be attributed to several factors, including the learning curve associated with radial access, smaller caliber and more tortuous anatomy of the radial artery, and a higher likelihood of encountering arterial spasm during cannulation (15, 16). Additionally, the radial approach may require more complex catheter manipulation, further contributing to the increased procedural time.

Although our study showed a longer procedural time for the radial approach, it is essential to consider the potential advantages of radial access over femoral access in PPCI, including a lower risk of bleeding complications, shorter hospital stays, and improved patient comfort (17, 18). Recent large-scale trials, such as the MATRIX and RIVAL studies, have demonstrated non-inferior or even superior outcomes with radial access compared to femoral access for patients undergoing PPCI, with a significant reduction in bleeding complications (19, 20).

It is also worth noting that the learning curve associated with radial access may impact procedural time, and experienced radial operators may achieve shorter procedural times with increased case volumes (21). In our study, we performed a subgroup analysis stratified by the operator's annual PPCI case volume and found that the difference in procedural time between radial and femoral approaches was less pronounced among high-volume operators. This finding suggests that increased operator experience may help mitigate the longer procedural times observed with radial access.

Conclusion

In conclusion, our study demonstrated that the radial approach for PPCI in acute STEMI patients was associated with a longer procedural time (wire crossing time) compared to the femoral approach. However, considering the potential benefits of radial access, such as reduced bleeding complications and improved patient comfort, the longer procedural time may be an acceptable trade-off. Further research is needed to identify strategies to reduce procedural time in radial PPCI, especially among less experienced operators, and to evaluate the impact of longer procedural times on clinical outcomes in the context of the well-established benefits of radial access.

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