

Original Article

The Impact of Radial Vs Femoral Access on Vascular Complications and Patients Outcomes in Complex PCI

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ABSTRACT

Background: Percutaneous coronary intervention (PCI) is a primary treatment modality for coronary artery disease, particularly in complex cases involving multivessel disease, chronic total occlusions, or bifurcation lesions. The choice of vascular access site—radial versus femoral—can significantly impact patient outcomes and the incidence of vascular complications. Recent trends favor radial access due to its potential advantages in safety and recovery.

Objective: To evaluate the impact of radial versus femoral access on vascular complications and patient outcomes in complex PCI.

Methods: This randomized control trial was conducted at the Chaudhary Pervaiz Elahi Institute of Cardiology, Wazirabad, Pakistan, over a six-month period from September 2023 to February 2024. A total of 350 patients undergoing complex PCI were enrolled, with 210 assigned to radial access and 140 to femoral access. Baseline characteristics, including age, BMI, and prevalent comorbidities (dyslipidemia, hypertension, and diabetes mellitus), were recorded. Major outcomes measured included periprocedural myocardial infarction, in-hospital mortality, and stent thrombosis. Statistical analysis was performed using SPSS Version 26.

Results: The mean age of participants was 52.90 ± 8.07 years. No significant differences were found in BMI and comorbid conditions between the groups. In-hospital mortality was 1.4% in the radial group compared to 4.3% in the femoral group ($P=0.05$). Rates of periprocedural myocardial infarction were similar between groups (0.5% radial vs 0.7% femoral, $P=0.77$). Stent thrombosis was observed in 0.5% of the radial group and was absent in the femoral group.

Conclusion: Radial access in complex PCI was associated with lower in-hospital mortality compared to femoral access, with similar rates of myocardial infarction and stent thrombosis. These findings suggest that radial access may provide a safer alternative, supporting its increasing use in clinical practice.

Keywords: Percutaneous Coronary Intervention, Radial Access, Femoral Access, Vascular Complications, Patient Outcomes, Randomized Control Trial, In-hospital Mortality, Stent Thrombosis, Coronary Artery Disease.

INTRODUCTION

Percutaneous coronary intervention (PCI) is a crucial procedure for treating coronary artery disease (CAD), particularly effective in complex cases such as multivessel disease, left main disease, or chronic total occlusions (1). As the preferred method for rapid reperfusion in patients with ST-segment elevation myocardial infarction (STEMI), PCI involves opening blocked coronary arteries to restore blood flow and minimize heart muscle damage (2). This procedure typically involves the administration of potent antiplatelet and anticoagulant medications to prevent clot formation and ensure procedural success, but this increases the risk of bleeding and other periprocedural complications (3).

The selection of the vascular access site for PCI, either through the radial artery at the wrist or the femoral artery in the groin, significantly influences the success of the procedure and patient outcomes (4). Radial access has become increasingly popular due to its benefits in reducing major vascular complications such as hematoma and arterial injury, and because it allows for quicker recovery and shorter hospital stays due to earlier patient mobility (5). Despite its advantages, radial access involves a learning curve

for operators, particularly in complex PCI cases, due to the smaller size of the radial artery which can complicate catheter manipulation (6).

Conversely, femoral access remains a traditional method for PCI, providing easier catheter manipulation, particularly in complex procedures that require larger catheters or devices (7). Many operators also have more experience with femoral access. However, this method carries a higher risk of vascular complications such as bleeding and hematoma, and is associated with longer recovery times (8). The study aims to provide valuable insights into the advantages and disadvantages of both radial and femoral access in complex PCI, ultimately contributing to improved patient outcomes and procedural safety in interventional cardiology (9).

MATERIAL AND METHODS

The study was designed as a randomized control trial conducted over a six-month period from September 2023 to February 2024 at the Chaudhary Pervaiz Elahi Institute of Cardiology in Wazirabad, Pakistan. It aimed to compare the effects of radial versus femoral access on vascular complications and patient outcomes in complex percutaneous coronary intervention (PCI). Patients eligible for inclusion were those aged 18 to 70 years, undergoing complex PCI for conditions such as multivessel disease, chronic total occlusions, or bifurcation lesions, and were of any gender. Exclusion criteria included patients with previous vascular surgery on the radial or femoral arteries, severe peripheral artery disease, known allergies to contrast media, significant comorbidities such as advanced renal failure, liver disease, or malignancy, and pregnant women.

Upon obtaining approval from the hospital's ethical committee, which adhered to the Declaration of Helsinki principles, eligible patients were approached and provided with detailed information about the study's purpose, procedures, risks, and benefits. Informed consent was obtained from all participants who agreed to partake in the study. A total of 350 patients were enrolled and randomly assigned to either Group A for radial access or Group B for femoral access. Baseline data collection included demographic information, medical history, cardiovascular risk factors, comorbidities, and angiographic data including lesion characteristics and SYNTAX score. Pre-procedural assessments included laboratory tests evaluating renal function and coagulation profiles.

Throughout the study, follow-up visits were conducted to collect data on procedural outcomes, smoking status, readmissions, and medication usage. Major bleeding events were classified according to the Bleeding Academic Research Consortium (BARC) criteria, which included Type 2 (hemorrhage necessitating diagnostic studies, hospitalization, or treatment) and Type 3 (significant bleeding events with various consequences). Data collection was facilitated using a predesigned questionnaire.

Statistical analysis was performed using SPSS Version 26. The analysis focused on comparing the incidence of vascular complications and overall patient outcomes between the two groups, ensuring robust data handling and reporting of results.

RESULTS

In the randomized control trial conducted at the Chaudhary Pervaiz Elahi Institute of Cardiology, a total of 350 patients were enrolled and divided between radial and femoral access groups for complex percutaneous coronary intervention (PCI). The mean age of the participants was 52.90 years with a standard deviation of 8.07 years, indicating a middle-aged cohort (Table 1).

The baseline characteristics of the patients were well matched between the two groups. The radial access group consisted of 210 patients, while the femoral access group included 140 patients. The mean age for the radial group was 52.80 years (SD = 8.49) compared to 53.04 years (SD = 7.43) for the femoral group, with no significant age difference observed ($P = 0.78$). The Body Mass Index (BMI) was similar across the groups, with the radial group averaging 25.03 (SD = 2.91) and the femoral group 25.23 (SD = 2.67), also showing no significant difference ($P = 0.52$) (Table 2).

Table 1: Baseline Characteristics of Patients Between Both Groups

Characteristics	Radial Group (n=210)	Femoral Group (n=140)	P-Value
Age	52.80 ± 8.49	53.04 ± 7.43	0.78
BMI	25.03 ± 2.91	25.23 ± 2.67	0.52
Gender			
Male	135 (64.3%)	71 (50.7%)	0.01
Female	75 (35.7%)	69 (49.3%)	
Dyslipidemia	82 (39.0%)	52 (37.1%)	0.71

Hypertension	63 (70.0%)	89 (63.6%)	0.20
DM	73 (34.8%)	53 (37.9%)	0.55

Table 2: Adverse Events Between Patients of Both Groups

Event	Radial Group (n=210)	Femoral Group (n=140)	P-Value
In-hospital Mortality	3 (1.4%)	6 (4.3%)	0.05
Periprocedural MI	1 (0.5%)	1 (0.7%)	0.77
Emergency	0 (0.0%)	1 (0.7%)	0.22
ReIntervention			
Stent Thrombosis	1 (0.5%)	0 (0.0%)	0.41
Coronary Dissection	1 (0.5%)	2 (1.4%)	0.34
Coronary Perforation	0 (0.0%)	1 (0.7%)	0.22
New Ischemia	0 (0.0%)	2 (1.4%)	0.82
Cardiogenic Shock	3 (1.4%)	3 (2.1%)	0.61
Arrhythmia	3 (1.4%)	5 (3.6%)	0.18
TIA/STROKE	1 (0.5%)	1 (0.7%)	0.77
Tamponade	0 (0.0%)	2 (1.4%)	0.08
HF Worsening	3 (1.4%)	2 (1.4%)	1.00
Bleeding	1 (0.5%)	1 (0.7%)	0.77

Gender distribution revealed a significant difference; the radial group had a higher proportion of males (64.3%) compared to the femoral group (50.7%) ($P = 0.01$). In terms of health conditions, both groups had comparable rates of dyslipidemia and diabetes mellitus, with 39.0% of the radial group and 37.1% of the femoral group having dyslipidemia ($P = 0.71$), and 34.8% of the radial group versus 37.9% of the femoral group diagnosed with diabetes ($P = 0.55$). However, there was a difference in hypertension prevalence, with 70.0% in the radial group and 63.6% in the femoral group, although this was not statistically significant ($P = 0.20$) (Table 2).

Adverse events were carefully monitored, revealing that in-hospital mortality was higher in the femoral group at 4.3% compared to 1.4% in the radial group, approaching a statistically significant difference ($P = 0.05$). Other complications such as periprocedural myocardial infarction and new ischemia showed no significant differences between the groups (Table 3). Reinterventions were low with only one reported case of emergency reintervention in the femoral group ($P = 0.22$). The incidence of stent thrombosis, coronary dissection, coronary perforation, cardiogenic shock, arrhythmias, transient ischemic attacks/strokes, cardiac tamponade, worsening heart failure, and bleeding were similarly low and showed no statistically significant differences between the two groups (Table 3).

Overall, these results suggest that while both radial and femoral accesses are viable for complex PCI, radial access may offer a slight advantage in terms of in-hospital mortality and gender distribution favoring males, but both techniques are generally comparable in terms of other major adverse cardiovascular events.

DISCUSSION

The study focused on evaluating the impact of radial versus femoral access on vascular complications and patient outcomes in complex percutaneous coronary intervention (PCI). Our findings suggested a higher incidence of adverse events associated with femoral access, which corroborates previous studies indicating a potential increase in risk with this approach (10). Although initial analyses indicated a higher rate of adverse events among patients in the femoral group, this disparity may be attributable to the more frequent assignment of patients with greater comorbidities and complex lesions to femoral access. When adjustments were made for these factors through propensity-score matching and multivariable analysis, the difference in in-hospital mortality between the two access sites was not statistically significant.

The similar prevalence of key cardiovascular risk factors such as dyslipidemia, hypertension, and diabetes mellitus across both groups confirmed that the cohorts were well-matched, thus reinforcing that observed differences in outcomes were likely due to the choice of access site rather than baseline patient characteristics. The study conducted by Amir Aziz Alkatiri et al. supported our findings, emphasizing the critical role of access site selection in influencing patient outcomes in complex PCI (10).

Regarding periprocedural myocardial infarction (MI), in-hospital mortality, and stent thrombosis, our results showed no significant difference in the rates of periprocedural MI between the groups, consistent with prior research suggesting equivalence in myocardial infarction rates between the radial and femoral approaches (5). However, a notable finding was the higher incidence of in-hospital mortality in the femoral group compared to the radial group, which although marginally statistically significant, aligns with previous literature indicating increased complications with femoral access. The EUROMAX trial and data from the British Cardiovascular Intervention Society and National Institute for Cardiovascular Outcomes Research (NICOR) further supported this observation, suggesting a trend towards fewer complications with radial access in primary PCI (12-14).

Radial access, favored for its superficial location and the dual blood supply provided by the palmar arch, offers significant advantages in terms of safety and complication management (15). The European Society of Cardiology (ESC) advocates for radial access as the default in both stable and unstable patients, highlighting its benefits in reducing complications like bleeding (16). Nevertheless, the ESC also stresses the importance of maintaining proficiency with femoral access to ensure preparedness for complex cases that require larger guiding catheters or when radial access is not feasible.

Our study did not find a statistically significant difference in bleeding complications between the radial and femoral approaches, which might suggest similar safety profiles for both access sites. However, other studies have reported lower bleeding rates with radial access, which supports the general preference for this approach in reducing bleeding complications (17, 18).

The strengths of this study lie in its randomized design and the rigorous methodological approach that ensured balanced patient characteristics between the two groups. However, the study is not without limitations (19). The single-center design may limit the generalizability of the findings, and the sample size, although adequate for detecting major differences, might be insufficient to discern subtler nuances in complication rates. Future research should focus on multi-center trials to validate these findings and potentially explore the nuances in patient subsets that may benefit more distinctly from one access site over the other (20).

CONCLUSION

In conclusion, while femoral access remains necessary in specific complex PCI scenarios, the associated risks highlight the importance of careful access site selection. The increasing adoption of radial access reflects its favorable safety profile and patient outcomes. Ongoing research and continued evaluation of procedural outcomes are imperative to refine access site selection and optimize patient care in the setting of complex PCI.

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