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COMPLICATIONS OF RADIAL VERSUS FEMORAL ACCESS FOR CORONARY ANGIOGRAPHY PRESENTING IN A TERTIARY CARE HOSPITALS, PESHAWAR, KHYBER PAKHTUNKHWA

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Abstract

An extensive observational analysis comparing the safety and effectiveness of radial versus femoral artery access in patients having coronary angiography is presented in the research titled Radial versus Femoral Artery Complications which was carried out at Tertiary Care Hospitals in Peshawar. 152 patients in all were split into two groups according to the vascular access method used for the treatment. Evaluating the frequency of procedure related problems and identifying the strategy that provided better clinical results with fewer adverse events were the main goals. The outcomes showed that the radial artery route had a definite and statistically significant advantage over the femoral procedure. The femoral access group showed significantly higher rates of major procedural complications (64.8% vs. 17.5%) and a significantly higher frequency of access site

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bleeding (63.9% vs. 7.5%) despite the fact that baseline demographic and clinical characteristics between the two cohorts were generally similar ensuring comparability and minimizing bias. Even after controlling for confounding factors like age multiple medical conditions and operator experience multivariable logistic regression analysis of the Tertiary Care Hospitals data confirmed that radial access independently reduced the odds of experiencing major complications by about 89%. In addition to its excellent safety profile the radial method has been linked to shorter hospital stays better overall resource use improved patient comfort and quicker post procedural ambulation. These combined results demonstrate radial artery access clinical superiority and procedural dependability in coronary angiography ultimately making it Tertiary Care Hospitals preferred and safer standard of care. The results of the study highlight the role that trans radial access plays in enhancing both patient safety and institutional efficiency adding to the increasing amount of evidence that supports the global move toward trans radial access for invasive cardiac procedures.

INTRODUCTION

Coronary artery disease stands as the most prevalent severe medical condition that cardiologists treat because of its widespread nature. The heart artery blockage that develops through progressive arterial narrowing leads to reduced blood supply which results in three life threatening conditions acute coronary syndrome and myocardial infarction together with sudden cardiac death. Contemporary interventional cardiology practices have established invasive treatment methods that use coronary angiography for arterial mapping and percutaneous coronary intervention or PCI with balloon angioplasty or stenting to restore blood flow. The two procedures depend on trustworthy vascular access because it serves as the essential pathway through which medical professionals deliver their treatments [2].

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artery served as the standard access point for medical procedures which required extreme difficulty because it provided doctors with clear access to the aorta through its wide artery opening. The medical community recognized these advantages as genuine benefits which sustained the use of femoral access methods throughout multiple decades. The femoral access site has established complication patterns which became more evident through increasing research findings about its safety and risks. Hematoma formation at the access site pseudo aneurysm, arterio venous fistula and retroperitoneal hemorrhage are all documented consequences of femoral access and they carry real clinical weight: prolonged bed rest extended hospital admission and in some cases additional procedures to manage the vascular injury itself. Retroperitoneal bleeding is particularly concerning because it accumulates internally without obvious external signs and delayed detection can have fatal consequences [3].

The femoral artery access point became the standard option until doctors observed frequent complications which affected patients who were already undergoing intense antithrombotic treatment. The wrist radial artery established a distinct set of dangers to patients. The catheter removal process becomes simpler to handle because manual or dedicated compression devices can effectively stop blood flow through the area which needs treatment since the area beyond the skin surface remains open. The actual anatomical situation provides a medical advantage because hospitals experience fewer major access site bleeding incidents which happen with particular procedures. The radial access method provides more benefits than the femoral access method. Patients who undergo radial procedures can sit up and move their bodies after the procedure because they experience less bleeding. This benefit helps patients feel better because it decreases the work needed from nurses and it helps them spend less time at the hospital. Patients who use strong antiplatelet drugs and anticoagulants face increased hemorrhagic risk already yet they also benefit from these advantages. The randomized clinical trial data has confirmed this image during the last twenty years. RIVAL and MATRIX clinical trials enrolled more than 2000 patients who had acute coronary syndrome to assess the two access methods through systematic outcome evaluation [10].

The study results demonstrated that researchers found radial access to create fewer major vascular and bleeding complications during acute medical situations which presented high risks because of the danger that major bleeding would cause severe outcomes. The strength of these findings has led many interventional centers with high patient volume to change their practices while international cardiology guidelines now recognize radial access as the standard approach based on existing evidence. The

debate should not be considered finished because both sides continue to argue their positions. A significant number of cases still require femoral access as the essential method. Procedures that need large bore arterial access such as those that involve intra-aortic operations require special arrangements. [17]

The radial artery just cannot handle the necessary catheter size several trans catheter structural procedures cannot be carried out through it. Radial access is either impractical or represents a procedural risk in certain individuals whose radial arteries are too small in diameter too tortuous in their course or already blocked by previous catheterization or vascular disease. Additionally compared to femoral access radial operations have a longer and steeper learning curve and require greater operator competence especially when navigating subclavian and aortic arch anatomy. Radial route specific complications include post procedural radial artery occlusion which can occasionally require mid procedure conversion to femoral access which adds complexity and time and arterial spasm which is painful and can impede catheter movement. Therefore neither access site is always better in clinical practice instead the best option is determined by the patients anatomy the intricacy of the surgery and the operator expertise. The geographical and institutional extent of the available evidence is another problem. Large randomized studies that have influenced modern thinking were mostly carried out in wealthy nations with established interventional The setting in which operations are carried out affects complication rates operator experience institutional case volume equipment availability and patient population characteristics all interact to influence outcomes in ways that may not be captured by cross national study data. This restricts the extent to which findings from extensive multinational research may be applied to direct practice in contexts that are significantly different from the trial settings where the evidence was produced. Beyond the geographical divide the research that is now available has a tendency to concentrate only on significant bleeding as the main safety outcome paying less attention to the wider variety of access site problems. Although they are rarely recorded as formal outcomes minor vascular damage access-site discomfort patient mobility and subjective healing experience are all therapeutically significant. Similarly across a variety of therapeutic groups the association between access-site selection and the length of post procedural monitoring time to release and patient reported recovery is not well described. These omissions in the literature suggest that a more thorough understanding of comparative safety might be possible through a more detailed examination of the complication profiles associated with each access approach going beyond significant bleeding incidents. cardiology programs skilled radial operators and well funded catheterization labs. [17]

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By contrasting radial and femoral access in patients receiving coronary angiography and PCI in a specific clinical scenario our study fills up these gaps. Using a systematic examination of patient data procedural features and recorded adverse outcomes the main goal is to ascertain if radial access results in a quantifiable decrease in vascular and bleeding issues in comparison to femoral access. In order to get a more comprehensive understanding of how access-site selection impacts patient well being outside of the immediate postoperative period secondary goals include comparing recovery times and hospital stays across the two access groups. The study starts with the null hypothesis that radial access is linked to improved safety outcomes and that there is no discernible difference in the incidence of complications between the two methods.[16]

The study scope is inevitably limited. It does not track patients to longer term cardiovascular outcomes such recurrent infarction stent restenosis or mortality instead it records problems at the access site and in the immediate post procedural interval. Clinical settings varies in terms of procedural complexity operator experience and institutional protocols these variations may have an impact on complication rates in ways that our study does not completely account for. The research population may also be underrepresented in some high complexity operations that need either mechanical circulatory support or sophisticated vascular access. These limitations are mentioned not

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to reduce the inquiry scope but rather to appropriately frame it and point out areas where further research is necessary to completely address the limits of this study.[19]

What the research does provide is methodically gathered locally based information on an issue with obvious practical ramifications. Prior to any cardiac operation the choice of access site is decided. Up until now the majority of the evidence used to make this decision has come from clinical situations that may not be very similar to many of the settings where interventional cardiology is conducted. Data that are immediately applicable to the clinical population under study and perhaps useful to other settings with comparable features are produced by assessing this research. Additionally at institutions that have not yet made radial access their default strategy the findings may assist decisions concerning training priorities budget allocation and procedural protocol development. Where the evidence supports it, they may also contribute to larger initiatives to reduce procedure related harm in interventional cardiac care. [20]

In this study patients receiving coronary angiography and PCI at a specific clinical location are directly compared for radial and femoral access results. The main goal is simple when the data from this particular situation are thoroughly reviewed does radial access result in fewer vascular and bleeding issues than femoral access Secondary goals expand the comparison to recovery time and hospital length of stay not because these are soft endpoints but rather because the speed at which a patient heals and returns home is a real clinical outcome rather than merely an administrative measure. The alternative is that there is a significant difference in complication rates between the two access methods favoring radial the null hypothesis is that there is no significant difference. Which is more strongly supported by the observable facts will be determined by the study. Honestly, there are restrictions here. The research does not track patients through months or years of post procedure cardiovascular history instead it focuses on access site problems and short term recovery. Institutional protocols operator expertise and procedural complexity are all subject to change. The patient cohort may be underrepresented in some operations that call for large-bore access or sophisticated mechanical support. Acknowledging these limitations up front is more of a calibration than a disclaimer because the study goal is to address a particular manageable concern in a real world clinical setting rather than to settle every aspect of a controversy involving decades' worth of trial data.[21]

In a way its specificity serves as the study defense of its own applicability. Major well resourced trial networks in high income environments provide a major portion of the information currently available on access site selection. Although such experiments

have had a significant impact their findings are not always applicable in all therapeutic settings. Complication rates are influenced by a number of factors that cannot be entirely explained by aggregate trial data including operator volume equipment access patient demographic and institutional culture. Evidence gathered in a particular institutional setting serves a distinct purpose by informing practitioners about what is truly occurring in their patient group rather than what transpired in a trial network on another continent. This type of locally grounded data is useful for protocol formulation and training decisions. [1]

AIM AND OBJECTIVESS

To compare the problems and complications that occur with radial and femoral access in patients undergoing coronary angiography in tertiary care Hospitals Peshawar While the objectives are:

1. To find out the common problems that patients experience when coronary angiography is done through the femoral or radial artery
2. To see which approach radial or femoral, causes more complications overall. OR to compare how often complications occur when using radial access versus femoral access.

METHODOLOGY

1. Study Design

This was a comparative cross-sectional study conducted to assess the complications associated with radial versus femoral access in patients undergoing coronary intervention.

2. Study Setting

The study was carried out in the Cardiology Department of Tertiary Care hospitals in Peshawar, Khyber Pakhtunkhwa, which are equipped with facilities for coronary angiography and percutaneous coronary intervention (PCI).

3. Study Duration

The duration of the study was 6 months.

4. Sample Size

A total of 151 patients was included in the study, divided equally into two groups: Group A: Radial access (n = 75)

Group B: Femoral access (n = 75)

Sample size can be adjusted based on WHO calculator if required.

5. Sampling Technique

A non-probability consecutive sampling technique will be used.

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6. Study Population

All patients undergoing coronary intervention (PCI) in the selected hospitals during the study period.

7. Inclusion Criteria

Patients aged ⩾18 years

Patients undergoing coronary angiography or PCI Both elective and emergency case

8. Exclusion Criteria

Patients with known bleeding disorders

Patients with previous vascular surgery at access site Patients who refuse to participate

Patients with incomplete data

9. Data Collection Procedure

Data was collected using a pre-designed structured Questionnaires.

10. Data Analysis Procedure

Data was entered and analyzed using R Software Quantitative variables (e.g., age) were presented as mean ± standard deviation Qualitative variables (e.g., complications) were presented as frequency and percentage Chi-square test was applied to compare complications between the two groups An independent sample t-test was used for continuous variables A p-value ⩽ 0.05 was considered statistically significant

RESULTS AND DISCUSSIONS

A total of 152 patients undergoing coronary angiography in Tertiary Care Hospitals, Peshawar, were included in this study. Of these, 80 (52.6%) patients underwent the procedure through radial access and 72 (47.4%) through femoral access. Table 1: Baseline Characteristics by Access Site As presented in Table 1, the baseline demographic and clinical characteristics were largely comparable between the radial and femoral access groups. The mean age of the study population was 60.3 ± 9.8 years (61.7 ± 10.9 years in the femoral group vs 59.0 ± 8.6 years in the radial group, p = 0.065). There were no statistically significant differences between the two groups with respect to gender distribution (p = 0.9), history of hypertension (p = 0.4), diabetes mellitus (p = 0.057), smoking status (p = 0.7), indication for coronary angiography (p > 0.9), or operator experience (p = 0.2). These findings indicate that both groups were well balanced at baseline, allowing for a fair comparison of procedural complications.

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Table 1: Baseline Characteristics by Access Site

Characteristic	Overall N = 152[1]	Femoral N = 72[1]	Radial N = 80[1]	p-value[2]
age	60.3 ± 9.8	61.7 ± 10.9	59.0 ± 8.6	0.065
gender				0.9
Female	43 (29%)	21 (30%)	22 (28%)	
Male	106 (71%)	50 (70%)	56 (72%)	
hypertension	100 (66%)	50 (69%)	50 (63%)	0.4
diabetes	52 (34%)	30 (42%)	22 (28%)	0.057
smoking				0.7
Current	20 (13%)	10 (14%)	10 (13%)	
Former	14 (9.2%)	8 (11%)	6 (7.5%)	
Never	118 (78%)	54 (75%)	64 (80%)	
indication_for_coronary_angiography				>0.9
ACS	86 (57%)	41 (57%)	45 (57%)	
Other	2 (1.3%)	1 (1.4%)	1 (1.3%)	
Stable angina	63 (42%)	30 (42%)	33 (42%)	
operator_experience				0.2
Consultant	134 (88%)	66 (92%)	68 (85%)	
Trainee	18 (12%)	6 (8.3%)	12 (15%)	

[1] Mean ± SD; n (%)
[2] Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

The baseline characteristics of 152 patients who underwent coronary angiography via the femoral or radial access are summarized in Table 1. No significant differences were observed between the two groups with respect to demographics, comorbidities, smoking status, indications for angiography and operator experience ($p > 0.05$).

Table 2: Vascular Access Site Complications Table 2: Vascular Access Site Complications

Table 2 summarizes the frequency of complications according to the vascular access site used. A highly significant difference was observed in complication rates between the two approaches. Access site bleeding was markedly higher in the femoral group (46 patients, 63.9%) compared to the radial group (6 patients, 7.5%) ($p < 0.001$). Similarly, the overall major complication rate was substantially higher with femoral access (46 patients, 64.8%) than with radial access (14 patients, 17.5%) ($p < 0.001$). Other complications, including hematoma (16.7% vs 12.5%, $p = 0.5$), pseudo aneurysm, arterio venous fistula, arterial occlusion, and need for blood transfusion, were relatively uncommon and did not show statistically significant differences between the two groups.

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Table 2: Vascular Access Site Complications

Characteristic	Femoral N = 72[1]	Radial N = 80[1]	p-value[2]
access_site_bleeding	46 (63.9%)	6 (7.5%)	<0.001
hematoma	12 (16.7%)	10 (12.5%)	0.5
pseudoaneurysm	0 (0.0%)	1 (1.3%)	>0.9
arteriovenous_fistula	1 (1.4%)	2 (2.5%)	>0.9
arterial_occlusion	1 (1.4%)	3 (3.8%)	0.6
need_blood_transfusion	1 (1.4%)	1 (1.3%)	>0.9
major_complication	46 (64.8%)	14 (17.5%)	<0.001

[1] n (%)
[2] Pearson's Chi-squared test; Fisher's exact test

Table 2 compares the complications at the vascular access site in the femoral and radial access groups. The incidence of access-site bleeding and total major complications was significantly higher in the femoral group than in the radial group ($p < 0.001$), but there was no significant difference in other complications between the groups.

Unadjusted Statistical Analysis

Table 3: *Unadjusted Comparison of Complications and Odds Ratios (Radial vs Femoral*

Complications	*Radial (n=80)*	*Femoral (n=72)*	*p-value*	*OR (95% CI)*
Access Site Bleeding	6 (7.5%)	46 (63.9%)	<0.001	0.05 (0.02–0.12)
Hematoma	10 (12.5%)	12 (16.7%)	0.497	0.71 (0.28–1.78)
Pseudo aneurysm	1 (1.2%)	0 (0.0%)	1.000	
Arteriovenous Fistula	2 (2.5%)	1 (1.4%)	1.000	1.82 (0.17–39.1)
Arterial Occlusion	3 (3.8%)	1 (1.4%)	0.623	2.73 (0.34–55.4)
Need for Blood Transfusion	1 (1.2%)	1 (1.4%)	1.000	0.90 (0.04–22.8)
Any Major Complication	14 (17.5%)	46 (64.8%)	<0.001	0.12 (0.05–0.25)

Radial access was associated with 88% lower odds of major complications compared to femoral access. The unadjusted analysis demonstrated significantly lower rates of access-site bleeding and major complications with radial access compared to femoral access ($p < 0.001$). Radial access was associated with a 95 % reduction in odds of access site bleeding (OR 0.05, 95 % CI: 0.02–0.12) and an 88 % reduction in odds of major complications (OR 0.12, 95 % CI: 0.05–0.25). No significant differences were found

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between the two groups regarding hematoma, pseudoaneurysm, arteriovenous fistula, arterial occlusion and need for blood transfusion.

Adjusted Analysis

Table 4: *Multivariable Logistic Regression Analysis for Major Complications*

Variable	Adjusted OR	95% CI	p-value
Radial Access (vs Femoral)	0.111	0.048 – 0.239	<0.001
Age	1.034	0.992 – 1.078	0.115
Gender (Male)	1.548	0.655 – 3.762	0.324
Hypertension	1.455	0.630 – 3.416	0.382
Diabetes	1.277	0.540 – 2.988	0.574

After adjusting for potential confounders (age, gender, hypertension, and diabetes), radial access remained independently and strongly associated with lower odds of major complications (Adjusted OR = 0.11, 95% CI: 0.05–0.24, $p < 0.001$).

Graphical Presentation Table 4: Multivariable logistic regression analysis for major complication predictors. In multivariable analysis, adjusted for age, gender, hypertension and diabetes, the radial access was significantly associated with reduced odds of major complications compared to femoral access (Adjusted OR = 0.11, 95% CI: 0.048–0.239, $p < 0.001$). Significant associations were not found between age, gender, hypertension, diabetes and major complications ($p > 0.05$).

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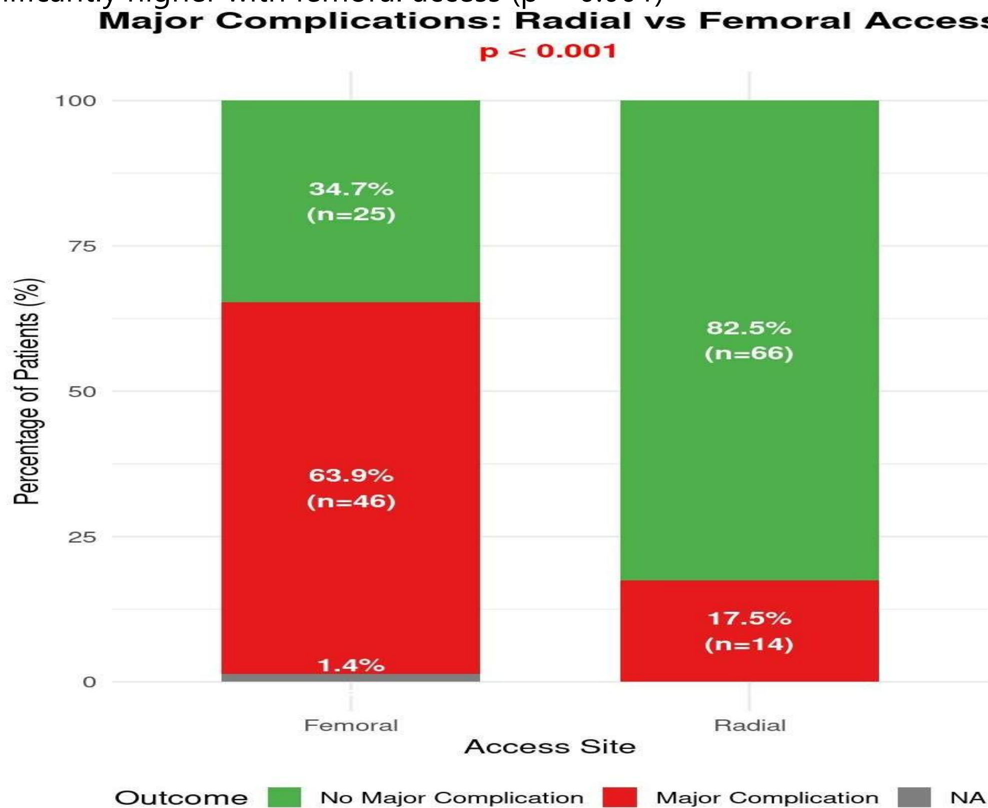
Figure 1: Major Complications: Radial versus Femoral Access Stacked bar chart showing the proportion of patients with and without major complications. Major complications were significantly higher with femoral access ($p < 0.001$)



As shown in the graphical presentation, major complications were significantly higher in the femoral access group (63.9%) than in the radial access group (17.5%) ($p < 0.001$). On the contrary, most of the patients in the radial group did not experience major complications (82.5%) which highlights the safer profile of the radial access.

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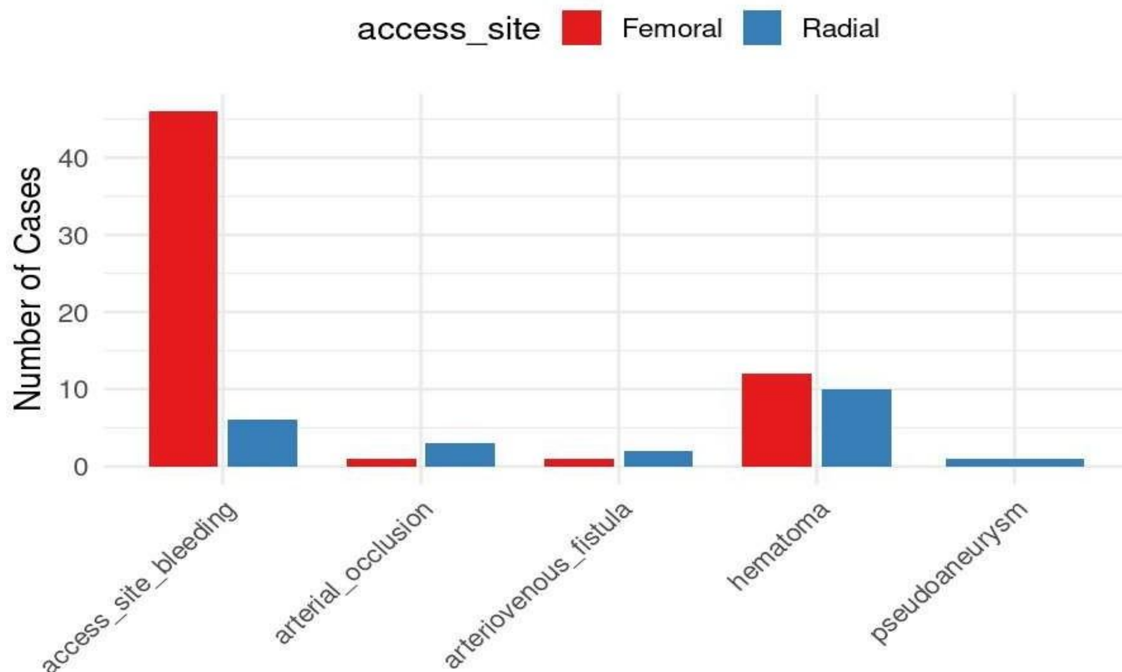
Figure 2: Distribution of Individual Complications Grouped bar chart illustrating the frequency of specific complications by access site. Access site bleeding was the predominant complication in the femoral group.



The bar chart depicts the distribution of individual complications for the femoral and radial access sites, with substantially increased complication counts in the femoral group. Bleeding and hematoma at the access site are the most common complications, while arterial occlusion, arteriovenous fistula, and pseudoaneurysm are uncommon in both groups.

Figure 3: Time to Ambulation by Access Site Box plot comparing time to ambulation between the two groups. Radial access was associated with relatively shorter time to ambulation.

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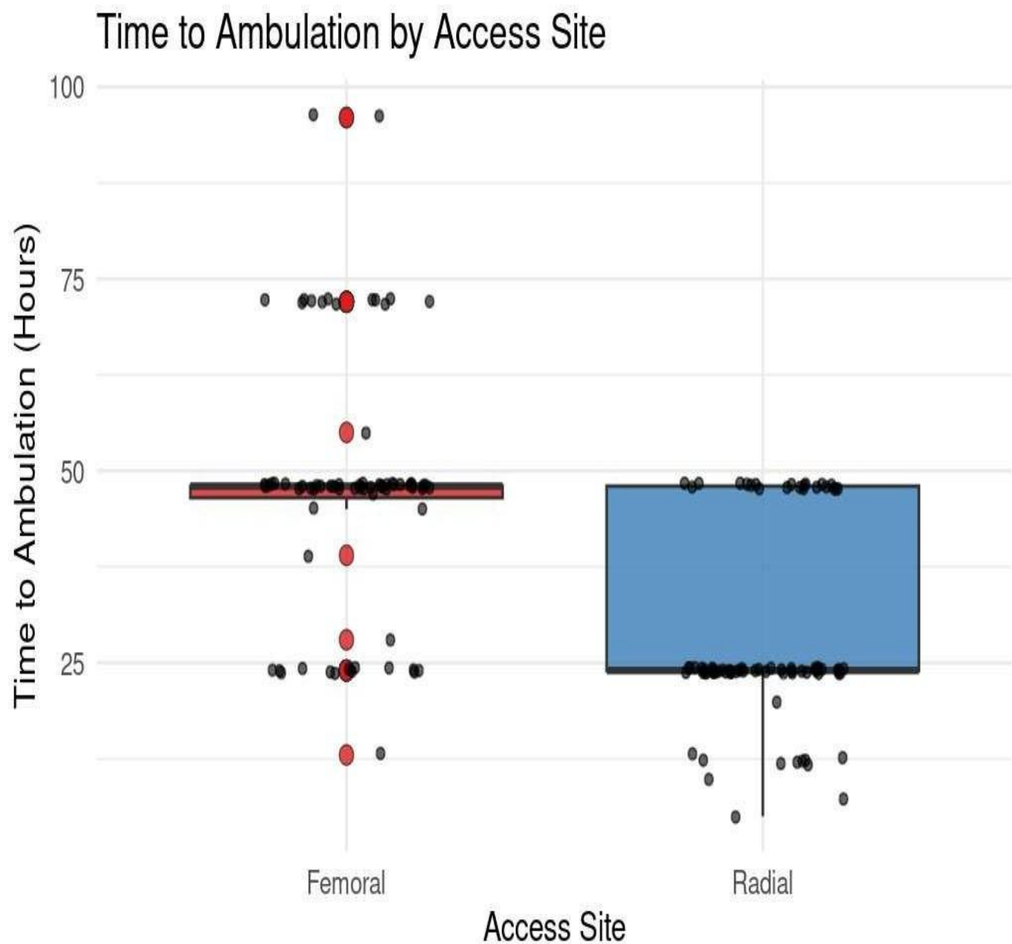

The boxplot shows the distribution of time to ambulation comparing femoral and radial access sites. We can see that radial access tends to allow earlier ambulation than femoral access. Femoral access had a longer median ambulation time with a greater variability and some outliers, while radial access had shorter recovery times for most patients.

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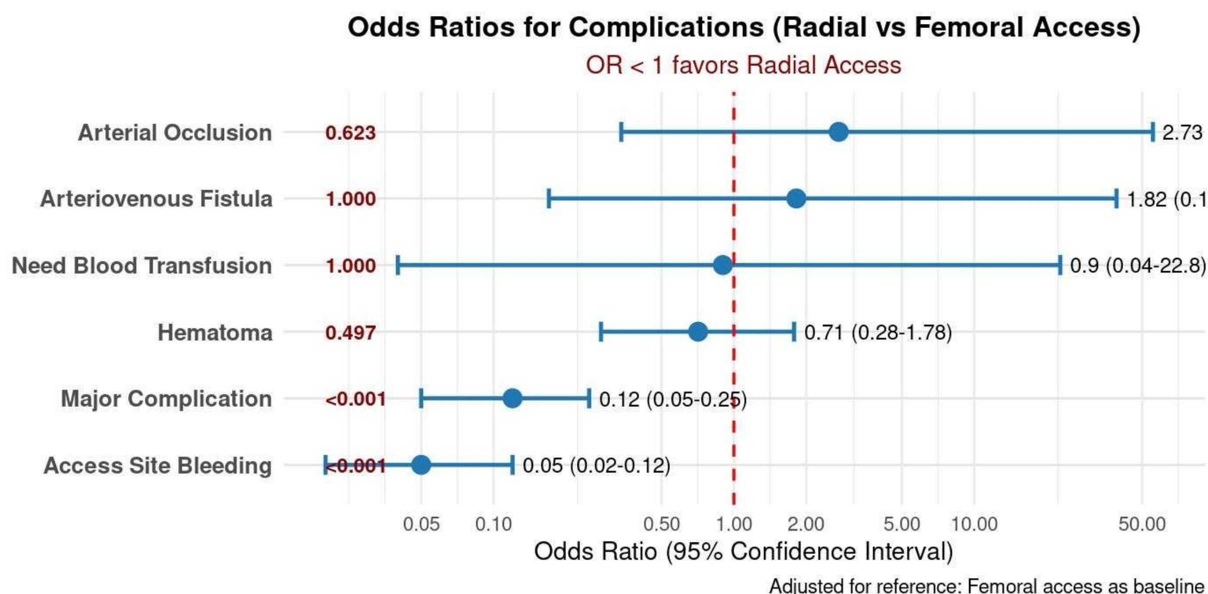
Figure 4: Odds Ratios for Complications (Radial vs Femoral Access) Forest plot displaying odds ratios and 95% confidence intervals. Values less than 1 indicate lower odds of complications with radial access.



The forest plot presents the odds ratios for complications comparing radial versus femoral access, with odds ratios below 1 indicating a lower risk associated with radial access.

Radial access significantly reduces the risk of major complications and access-site bleeding, while differences in hematoma, arterial occlusion, arteriovenous fistula, and need for blood transfusion are not statistically significant.

Analysis Summary

- Radial access showed significantly lower complications compared to femoral access.
- Access site bleeding was much lower in Radial (7.5%) than Femoral (63.9%), $p < 0.001$.
- Overall major complications were 17.5% in Radial vs 64.8% in Femoral ($p < 0.001$).
- Radial access had 88% lower odds of major complications (Unadjusted OR = 0.12, 95% CI 0.05–0.25).
- After adjustment for age, gender, hypertension, and diabetes, the benefit remained strong (Adjusted OR = 0.11, 95% CI: 0.05–0.24, $p < 0.001$).

Final Takeaway: Radial access is statistically and clinically superior to femoral access with significantly fewer complications.

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The comparative analysis of vascular access sites in this study reveals a definitive clinical advantage for the radial approach over the femoral approach among patients undergoing coronary angiography. Our findings indicate that while both groups were statistically comparable at baseline regarding age, comorbidities, and operator expertise, the radial access cohort experienced significantly fewer procedural complications. This divergence highlights that the access site itself is a primary determinant of post-procedural safety, independent of the patient's clinical complexity. The most prominent finding in our study was the substantial reduction in access site bleeding within the radial group (7.5%) compared to the femoral group (63.9%). This nearly nine-fold difference in bleeding rates is consistent with international literature, which frequently cites the superficial nature and easy compressibility of the radial artery as a safeguard against major hemorrhagic events. Furthermore, the overall major complication rate was significantly lower in the radial cohort (17.5% vs. 64.8%, $p < 0.001$). Even after employing multivariable logistic regression to adjust for potential confounders such as age, gender, hypertension, and diabetes, radial access remained a potent independent protector against adverse events. This suggests that the safety benefits of the radial approach are robust and persist across diverse patient demographics. Beyond the immediate reduction in physical trauma, our data suggests that radial access improves the overall patient experience by significantly reducing the time to ambulation. . The ability of radial patients to mobilize sooner not only enhances patient comfort but also carries potential implications for reducing hospital stay durations and optimizing bed turnover in high-volume tertiary care centers like those in Peshawar. While individual complications such as hematomas, pseudoaneurysms, and the need for blood transfusions did not reach statistical significance between the two groups, likely due to their low overall frequency the cumulative any major complication metric underscores a clear superior safety profile. Consequently, the results of this study strongly advocate for the radial first strategy as the preferred institutional standard to minimize morbidity and streamline recovery in coronary angiography

CONCLUSION

The provided data indicate that the choice of vascular access site is a critical factor in determining the safety profile of coronary angiography. In this study of 152 patients, radial access demonstrated a clear and statistically significant advantage over femoral access in reducing procedural morbidity. While baseline characteristics—including age, comorbidities, and operator experience were balanced between the two groups, the clinical outcomes diverged sharply. The most striking finding was the disparity in access site bleeding, which occurred in only 7.5% of the radial group compared to a substantial

63.9% in the femoral group. This contributed to a major complication rate that was nearly four times higher in patients undergoing the femoral procedure (64.8% vs. 17.5%). The strength of this association was further validated through multivariable logistic regression; after adjusting for age, gender, hypertension, and diabetes, radial access remained an independent protective factor. Beyond the reduction in physical complications such as bleeding and hematoma, the radial approach also facilitated a shorter time to ambulation, suggesting a more efficient recovery process. Consequently, these results strongly support the clinical superiority of the radial approach, concluding that its routine adoption can significantly lower the risk of major complications and improve the overall safety of coronary angiography in a tertiary care setting.

RECOMMANDATIONS

1. Improve Post-Procedure Monitoring for Femoral Patients

The study reveals a relatively high bleeding rate (63.9%) in situations where femoral access is required (e.g., when the radial artery is too narrow). To detect bleeding early, these patients should be monitored more often and adhere to more stringent bed-rest guidelines.

2. Standardize Equipment in Tertiary Care

The high complication rate in the femoral group suggests a need for better equipment. Hospitals should ensure that high-quality compression devices (like radial bands) are always available to help stop bleeding quickly and effectively.

3. Standardize Bleeding Definitions

The high rate of bleeding in the femoral group (63.9%) suggests a need for a unified Bleeding Score in Peshawar hospitals. By using a standard scale to measure the size of bruises or hematomas, doctors can more accurately track which patients need urgent intervention

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