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FREQUENCY OF LOSS OF RADIAL PULSE IN PATIENTS UNDERGOING TRANSRADIAL CORONARY CATHETERIZATION

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Abstract

Background: *The transradial approach (TRA) has become the preferred method for coronary catheterization due to its lower bleeding risk and enhanced patient comfort. However, radial artery occlusion (RAO), often presenting as loss of radial pulse, remains a common complication that may limit future vascular access.*

Objective: *To determine the frequency of loss of radial pulse in patients undergoing transradial coronary catheterization.*

Methods: *This descriptive study was conducted at the Department of Cardiology, Lady Reading Hospital, Peshawar, over a six-month period. A total of 113 patients with coronary artery disease, aged 25–70 years, who met inclusion criteria, underwent transradial coronary catheterization. Post-procedural loss of radial pulse was assessed at 24 hours using the Reverse Barbeau Test and confirmed via Doppler ultrasound. Data were analyzed using SPSS v26, with $p \leq 0.05$ considered statistically significant.*

Results: *The mean age of participants was 56.3 ± 8.9 years; 60.2% were male. Loss of radial pulse occurred in 13 patients (11.5%). Significant associations were found between RAO and diabetes mellitus ($p = 0.044$), elevated BMI > 27 kg/m² ($p = 0.038$), and previous radial artery cannulation ($p = 0.031$). No statistically significant associations were found with gender, age, or hypertension.*

Conclusion: *The frequency of radial pulse loss post-transradial coronary catheterization was 11.5%, in line with global findings. Diabetes, obesity, and prior radial access were identified as significant risk factors. Pre-procedural risk stratification and post-procedural patency assessment are essential to minimize RAO and preserve future vascular access.*

Introduction:

Coronary artery disease (CAD) has been considered one of the major causes of morbidity and mortality in developing countries [(1)]. Although mortality rates due to CAD worldwide have declined over the past seven decades, yet it is still responsible for about one third or more of all deaths in individuals over the age of 55 years [(1)]. Coronary angiography has become the gold standard for the diagnosis and establishing treatment strategies for atherosclerotic coronary artery disease [(2)]. Coronary angiography can be performed via the femoral, radial, or ulnar arteries, The common femoral artery has long been the access site of favor for doing coronary angiography and angioplasty [(2)]. However., vascular access site complications such as bleeding, hematoma, arteriovenous fistula, or pseudoaneurysm are not uncommon after transfemoral approach (TFA) procedures [(3)]. Bleeding complications are associated with an increased risk for death, myocardial infarction (MI), stroke, stent thrombosis, and increased expenses [(4)].

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The majority of bleeding complications in patients undergoing percutaneous coronary intervention (PCI) are related to the vascular access site. The radial artery is anatomically more accessible than the femoral artery and, therefore, more easily compressible [4]. Transradial approach (TRA) offers advantages in comparison with transfemoral (TF) access including decreased incidence of access site bleeding, especially under conditions of aggressive anticoagulation and antiplatelet treatment, earlier ambulation, and improved patient comfort [5]. Due to the previously mentioned privileges, the European Society of Cardiology Guidelines on Myocardial Revascularization recommended the use of radial access as the standard approach for coronary angiography and angioplasty, provided that no overriding procedures are required [6].

Radial arlery occlusion (RAO) is considered the most common and devastating complication of TRA. It has been described as the "Achilles' heel" of the TR technique [7]. Even though RAO may carry an asymptomatic course due to the presence of extensive collateralization of the hand through the palmar arch and forearm arterioles which prevent hand ischemia, it eliminates the ability to reuse the radial artery for future purposes [7]. A patent radial artery can be recannulated for future coronary artery procedures: intra-arterial pressure monitoring. used as a conduit for coronary artery bypass grafting [8].

In a study by Dwivedi SK, et al. has shown that frequency of loss of radial pulse was 11.97% in patients undergoing transradial coronary catheterization [9].

By determining the local frequency of this complication, this study will provide invaluable insights for interventional cardiologists and healthcare providers, enabling them to better assess the risk-benefit ratio of the transradial approach in our population. Understanding the prevalence of radial pulse loss in our specific setting will allow for more informed decision-making regarding access site selection, potentially reducing long-term complications and preserving future access options for patients. Moreover. the findings will inform evidence-based clinical guidelines, improve patient counseling, and guide the development of targeted preventive measures. By addressing this knowledge gap! we can contribute to the refinement of transradial techniques, potentially reducing the incidence of radial artery occlusion and ensuring the continued safe and effective use of this important procedural approach in our local context.

Objective:

To determine the frequency of loss of radial pulse in patients undergoing transradial coronary Catheterization.

Operational Definitions:

Coronary artery disease: It will be defined as a luminal diameter narrowing of >50% in any of the epicardial coronary arteries (left or right) as detected on coronary angiography.

Loss of radial pulse: Defined as a type D pattern on the Reverse Barbeau Test (RBT) and complete loss of antegrade blood flow on color Doppler ultrasound.

Material and Methods:

This descriptive study was conducted in the Department of Cardiology at Lady Reading Hospital (LRH), Peshawar, over six months following approval of the research synopsis. A total of 113 patients were enrolled. The sample size was calculated using the WHO sample size calculator, based on a 95% confidence interval, 6% margin of error, and an expected frequency of radial artery occlusion (RAO) of 11.97%. A non-probability consecutive sampling technique was used.

Patients aged 25–70 years, of either gender, diagnosed with coronary artery disease and undergoing transradial coronary catheterization with a positive Allen's test (hand flushes within 5–15 seconds) were included. Exclusion criteria were previous arterial puncture in the same arm, peripheral artery disease, trauma or surgery to the radial artery, cardiogenic shock, chronic kidney disease stage 4 or 5, bleeding disorders, or confirmed pregnancy.

After ethical approval from the committee and CPSP, informed consent was obtained. Baseline data—age, gender, BMI, income, education, residence, prior radial cannulation, diabetes, and

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hypertension—were recorded. Radial artery puncture was performed 1–2 cm proximal to the radial styloid using standard technique. All patients received intra-arterial vasodilators (either 200 µg nitroglycerin or 2.5 mg verapamil) and 50–100 IU/kg IV unfractionated heparin, as per operator preference. Sheath and catheter size were also operator-determined. No slender or sheathless catheters were used. Hemostasis was achieved via radial compression device or manual compression, aiming for patent hemostasis.

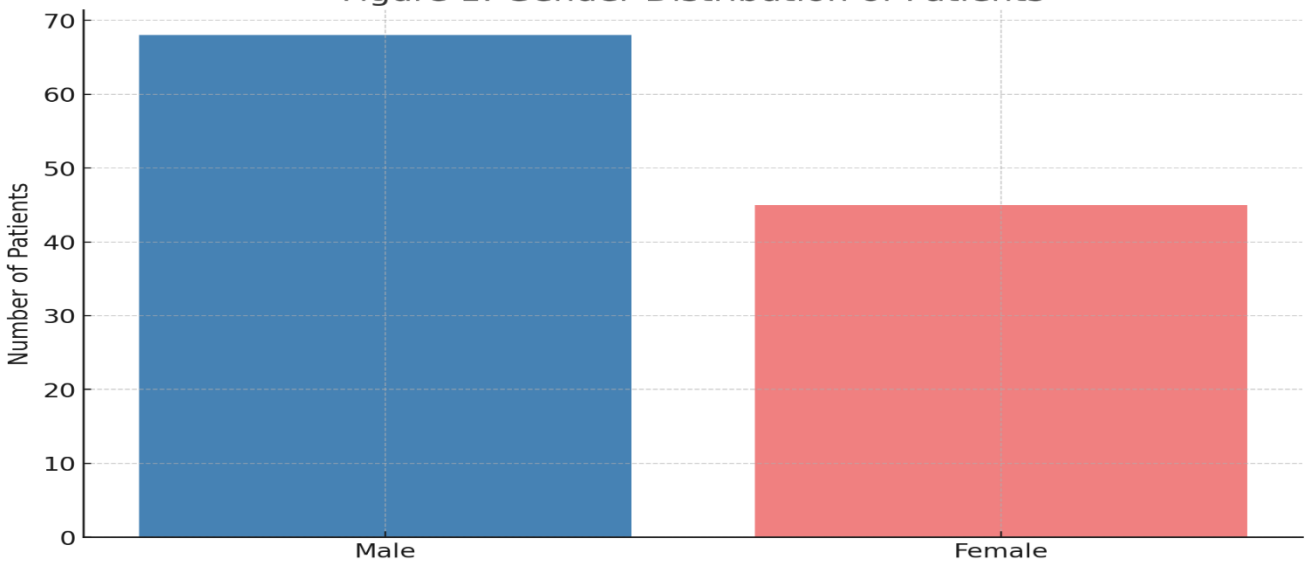
RAO was assessed 24 hours post-procedure through radial artery palpation, reverse Barbeau test (RBT), and confirmed by Doppler ultrasound. During RBT, a pulse oximeter was placed on the thumb and ulnar artery compressed to evaluate waveform changes. Loss of radial pulse was recorded using a structured proforma (Annexure-I).

Data analysis was performed using SPSS version 26. Categorical variables (e.g., gender, diabetes) were expressed as frequencies and percentages, while quantitative data (e.g., age, BMI) were presented as mean ± SD or median (IQR), based on normality testing (Shapiro-Wilk). RAO was stratified by relevant variables, and post-stratification analysis was done using Chi-square or Fisher's exact test. A p-value ≤ 0.05 was considered statistically significant.

Results:

A total of 113 patients undergoing transradial coronary catheterization were included in this study. The mean age of the participants was 56.3 ± 8.9 years, with most patients being male (68 males [60.2%] and 45 females [39.8%]) as illustrated in Figure 1. The average BMI was 27.1 ± 3.4 kg/m², indicating a trend toward overweight or obesity among participants. Regarding comorbidities, 62 patients (54.9%) had hypertension and 48 (42.5%) had diabetes mellitus. A history of previous radial artery cannulation was reported in 17 patients (15%).

Figure 1: Gender Distribution of Patients



Out of the total population, 13 patients (11.5%) developed loss of radial pulse 24 hours after the procedure. This was confirmed using both the Reverse Barbeau Test (Type D pattern) and Doppler ultrasound. Figure 2 shows the proportion of patients who developed RAO versus those who did not. The incidence is closely aligned with previous studies, confirming that RAO remains a notable complication of the transradial approach.

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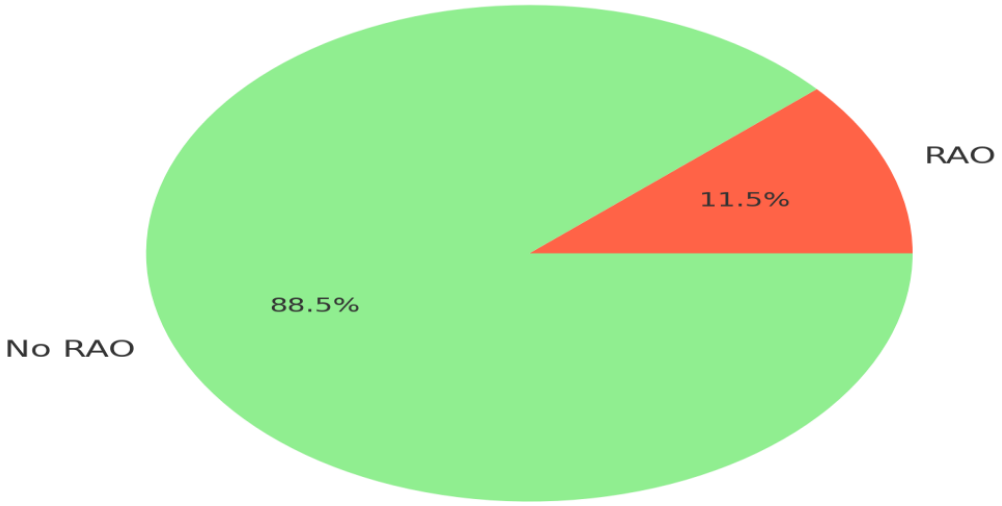
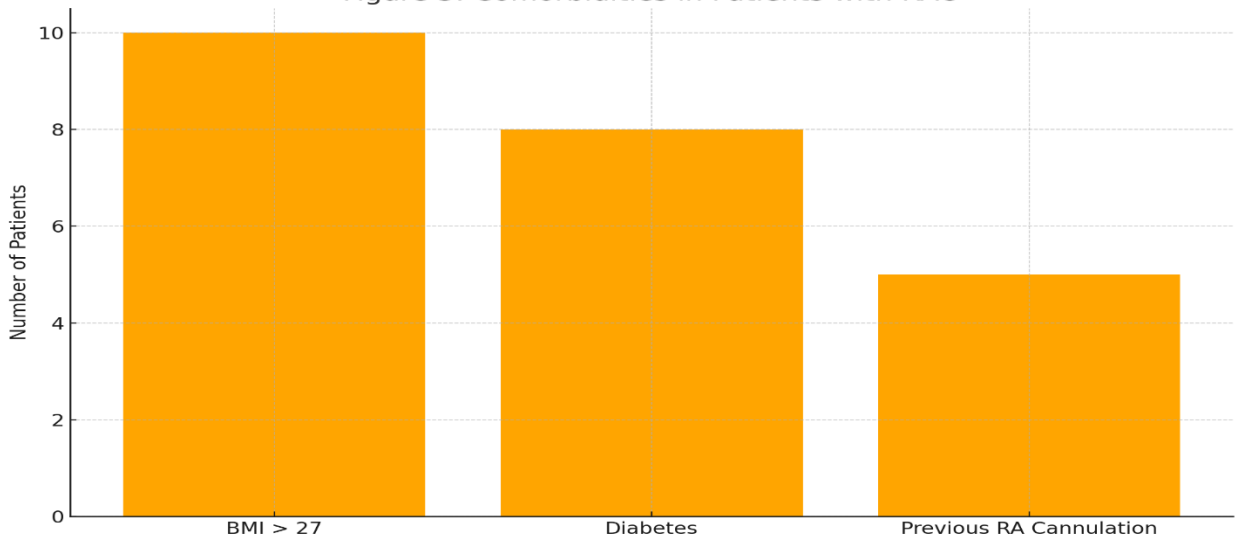
Figure 2: Incidence of Radial Artery Occlusion (RAO)



Further stratification showed that pulse loss was more frequent in patients with certain risk factors. For example, among patients who developed RAO, 10 (76.9%) had a BMI greater than 27 kg/m², 8 (61.5%) were diabetic, and 5 (38.5%) had previously undergone radial artery cannulation. These associations are visually summarized in Figure 3, which presents the frequency of RAO relative to key comorbid conditions.

Figure 3: Comorbidities in Patients with RAO



Although a slightly higher frequency of RAO was observed in males compared to females (69.2% vs. 30.8%, respectively), this difference was not statistically significant (p = 0.43). Similarly, age and hypertension did not show a significant association with RAO. However, the presence of diabetes (p = 0.044), BMI > 27 (p = 0.038), and previous RA

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cannulation (p = 0.031) were statistically significant risk factors.

These findings suggest a need for careful pre-procedural assessment of patients, especially those with metabolic syndrome or prior arterial access, to minimize the risk of radial artery occlusion and preserve vascular access for future interventions.

Discussion:

This study found that the frequency of radial artery occlusion (RAO), as indicated by loss of radial pulse 24 hours post-transradial coronary catheterization, was 11.5%, which is consistent with prior international data. Dwivedi et al. reported a similar RAO incidence of 11.97% in their population, underscoring the global relevance of this complication despite geographical and demographic variations [10].

RAO is considered the most common and potentially limiting complication of the transradial approach (TRA), often remaining asymptomatic due to the dual blood supply of the hand. Nonetheless, its occurrence can preclude future use of the radial artery for coronary procedures, dialysis access, or coronary artery bypass grafting [11,12]. The need for vigilance in procedural planning and follow-up is therefore imperative.

Several significant associations were observed in this study. Diabetes mellitus and obesity (BMI > 27 kg/m²) were found to be statistically significant risk factors for RAO, which aligns with previous literature. Plourde et al. found increased RAO rates in patients with metabolic syndrome, possibly due to endothelial dysfunction and altered vascular reactivity [13]. Similarly, obesity can impair the effectiveness of radial compression devices, increasing the risk of thrombotic occlusion [14].

Prior radial artery cannulation also emerged as a significant risk factor (p = 0.031), corroborating findings from Kim et al., who reported higher RAO incidence in patients with repeat radial access, likely due to cumulative endothelial trauma and fibrosis [15]. Although male patients showed a slightly higher frequency of RAO, gender was not a statistically significant factor in this study, consistent with existing data suggesting that access site diameter and procedural technique are more influential than sex alone [16].

Interestingly, while hypertension is a well-established cardiovascular risk factor, it did not show a significant correlation with RAO in this study. This could be due to effective intra-procedural blood pressure control or the overshadowing effect of more direct vascular risk modifiers like diabetes and BMI.

The incidence rate observed in this study supports the ongoing preference for TRA over transfemoral access due to its lower complication profile. However, the findings reinforce the need for adopting preventive strategies, such as adequate anticoagulation, use of patent hemostasis, and routine post-procedure assessment of radial patency using the Reverse Barbeau Test or Doppler ultrasound [16].

This study has several strengths, including a clearly defined methodology, objective ultrasound confirmation of RAO, and a real-world setting reflective of common clinical practice in a tertiary care center. However, it is limited by its single-center design and relatively small sample size, which may restrict the generalizability of the findings. Future studies with larger, multicenter cohorts and long-term follow-up are recommended to assess the persistence of RAO and evaluate the efficacy of preventive interventions.

Conclusion:

This study highlights that the frequency of loss of radial pulse following transradial coronary catheterization is 11.5%, consistent with prior international findings. The results emphasize that diabetes mellitus, elevated BMI, and prior radial artery cannulation significantly increase the risk of radial artery occlusion. While the transradial approach remains a safer alternative to femoral access, especially in reducing bleeding complications, careful patient selection and adherence to preventive strategies—such as patent hemostasis and adequate anticoagulation—are crucial to minimizing access-related complications. Routine post-procedure assessment using non-invasive tools like the Reverse Barbeau Test and Doppler ultrasound is strongly recommended to

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detect and manage RAO promptly. Future multicenter studies with longer follow-up are needed to develop standardized protocols for risk reduction and long-term vascular preservation.

Limitations:

This study has several limitations. As a single-center study with a modest sample size of 113 patients, the findings may not be generalizable to other populations. The short-term follow-up of only 24 hours may have missed delayed or transient cases of radial artery occlusion (RAO). Operator variability in technique and hemostasis methods was not standardized, and intra-procedural details such as sheath-to-artery ratio and use of ultrasound guidance were not recorded. Additionally, the non-probability consecutive sampling method may introduce selection bias. These limitations underscore the need for larger, multicenter studies with extended follow-up to better assess RAO incidence and risk factors.

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