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Frequency of Radial Artery Occlusion in Patients Undergoing PCI Through Radial Approach at a Tertiary Care Teaching Hospital in Lahore

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ABSTRACT

Introduction: Percutaneous Coronary Intervention (PCI), also known as coronary angioplasty or balloon angioplasty, is a minimally invasive procedure used to treat coronary artery disease (CAD). **Objective:** To determine the frequency of radial artery occlusion (RAO) in patients undergoing percutaneous coronary intervention (PCI) through radial approach. **Methodology:** This cross-sectional was conducted at Army Cardiac Hospital, Lahore from 1st August to 31st Jan. A non-probability consecutive sampling method was employed to select participants for the study. The PCI procedures were performed by a consultant radiologist, and the duration of the procedure was recorded. After 24 hours, a consultant cardiologist assessed the patients for the presence of RAO. If RAO was detected, appropriate therapy was provided based on the cardiologist's recommendations. **Results:** Data were collected from 145 patients, with a mean age of 58.3 ± 9.7 years, ranging from 18 to 75 years. Among the participants, 58.6% were male and 41.4% were female. The average body mass index (BMI) was 28.4 ± 4.2 kg/m². In terms of smoking status, 34.5% were smokers, while 65.5% were non-smokers. Regarding diabetes status, 27.6% of patients had diabetes, while 72.4% were non-diabetic. These demographic characteristics provide a comprehensive overview of the study population. Out of the 145 patients included in the study, 6 (4.1%) developed radial artery occlusion (RAO) within 24 hours following the PCI procedure. The remaining 139 patients (95.9%) did not experience RAO. This result suggests a relatively low incidence of RAO among patients undergoing PCI via the radial approach in the study population.

INTRODUCTION

Percutaneous Coronary Intervention (PCI), also known as coronary angioplasty or balloon angioplasty, is a minimally invasive procedure used to treat coronary artery disease (CAD) [1]. Coronary artery disease is caused by the buildup of plaque in the coronary arteries, leading to reduced blood flow to the heart muscle. PCI is performed to restore blood flow by opening the narrowed or blocked arteries which not only improves coronary flow but improves quality of life of patients [2]. PCI offers several advantages over traditional open-heart surgery including its minimally invasive nature, its ability to be performed on an outpatient basis and a very high success rate as compared to coronary revascularization surgery (CABG) which is a high risk, invasive procedure with essential post-operative hospital admission and longer duration to recovery and mobility [3].

Generally, PCI is a very safe procedure yet it is associated with some complications like any procedure. These include bleeding at the catheter insertion site, damage to blood vessels or the heart, blood clots, infection, and allergic reactions to contrast dye. However, the overall risk is relatively low, and complications can usually be managed effectively [4]. Another complication amongst these about which previous studies have shown high degree of variability

in terms of its frequency is radial artery occlusion in patients who undergo PCI via radial artery. In this instance, one study recently conducted reported that frequency of radial artery occlusion (RAO) in patients undergoing percutaneous coronary intervention (PCI) through radial approach was 39.7% [5]. In another study, a much lower frequency of radial artery occlusion (RAO) in patients undergoing percutaneous coronary intervention (PCI) through radial approach was found and was reported to be at 11.3% [6]. Contrary to both these studies, one study found that the frequency of radial artery occlusion in patients undergoing PCI through radial approach was merely 4% [7]. Radial artery occlusion (RAO) despite being not uncommon finding is a serious complication as it renders radial artery not useable for any further catheterization. In addition, previous literature has shown a very wide degree of variability regarding its burden. For this purpose, I am conducting this study with the aim of determining the frequency of radial artery occlusion (RAO) in patients undergoing percutaneous coronary intervention (PCI) through radial approach. Results from my study will not only let us know burden of this complication in our hospital setting but also help us to devise a preventive plan to avoid this potential complication of PCI.

Objective

To determine the frequency of radial artery occlusion (RAO) in patients undergoing percutaneous coronary intervention (PCI) through radial approach.

METHODOLOGY

This cross-sectional was conducted at Army Cardiac Hospital, Lahore over a period of six months after receiving approval from 1st August to 31st Jan.

Sample Size

The sample size was calculated using the WHO sample size calculator, based on the following assumptions: a 95% confidence level, 3.2% power, and an anticipated frequency of RAO in patients undergoing PCI via the radial approach of 4%. The calculated sample size was determined to be 145 patients, which was considered adequate to provide statistically significant results regarding the frequency of RAO in this population.

Inclusion Criteria

- Patients who were aged between 18 and 75 years and undergoing PCI via the radial approach were eligible for inclusion in the study.
- Both male and female patients were included, provided they met the inclusion criteria.

Exclusion Criteria

Patients were excluded from the study if they had a previous history of PCI, as verified by reviewing medical records. The study also excluded patients undergoing PCI via the femoral approach.

Data Collection Procedure

After obtaining approval from CPSP and informed consent from the participants, all patients who met the inclusion criteria were enrolled in the study from the PCI suite of Central Park Teaching Hospital. Those who met any exclusion criteria were not included in the study. Baseline characteristics, including age, gender, body mass index (BMI), smoking status, and diabetes status, were documented for all participants. The PCI procedures were performed by a consultant radiologist, and the duration of the procedure was recorded. After 24 hours, a consultant cardiologist assessed the patients for the presence of RAO. If RAO was detected, appropriate therapy was provided based on the cardiologist's recommendations. All data collected were kept confidential, and patient anonymity was maintained throughout the study. Personal identifiers were not documented, and a unique study number was assigned to each participant to ensure privacy.

Data analysis

Data were analyzed using SPSS version 22. Quantitative variables (age, BMI and duration of PCI) were presented as mean +/- standard deviation and median (IQR). Qualitative variables (gender, smoking status, diabetes status and presence of RAO) were presented as frequency and percentages. Data was stratified by age, gender, BMI, smoking status, diabetes status and duration of PCI to deal with effect modifiers.

RESULTS

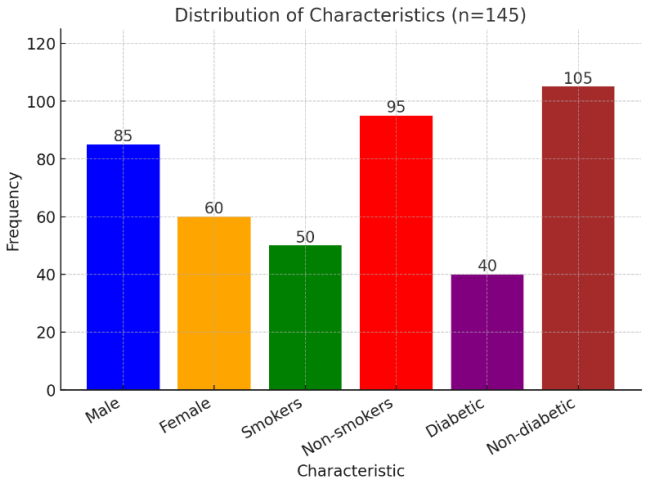
Data were collected from 145 patients, with a mean age of 58.3 ± 9.7 years, ranging from 18 to 75 years. Among the participants, 58.6% were male and 41.4% were female. The average body mass index (BMI) was 28.4 ± 4.2 kg/m². In terms of smoking status, 34.5% were smokers, while 65.5% were non-smokers. Regarding diabetes status, 27.6% of patients had diabetes, while 72.4% were non-diabetic. These demographic characteristics provide a comprehensive overview of the study population.

Table 1

Demographics and Clinical Characteristics of the Study Population

Characteristic	Value (n = 145)
Age (mean ± SD)	58.3 ± 9.7 years
Age Range	18-75 years
Gender (n, %)	
Male	85 (58.6%)
Female	60 (41.4%)
Body Mass Index (mean ± SD)	28.4 ± 4.2 kg/m²
Smoking Status (n, %)	
Smokers	50 (34.5%)
Non-smokers	95 (65.5%)
Diabetes Status (n, %)	
Diabetic	40 (27.6%)
Non-diabetic	105 (72.4%)

Figure 1



Out of the 145 patients included in the study, 6 (4.1%) developed radial artery occlusion (RAO) within 24 hours following the PCI procedure. The remaining 139 patients (95.9%) did not experience RAO. This result suggests a relatively low incidence of RAO among patients undergoing PCI via the radial approach in the study population.

Table 2

Incidence of Radial Artery Occlusion (RAO) in the Study Population

Outcome	Value (n = 145)
Number of Patients with RAO	6 (4.1%)
Number of Patients without RAO	139 (95.9%)

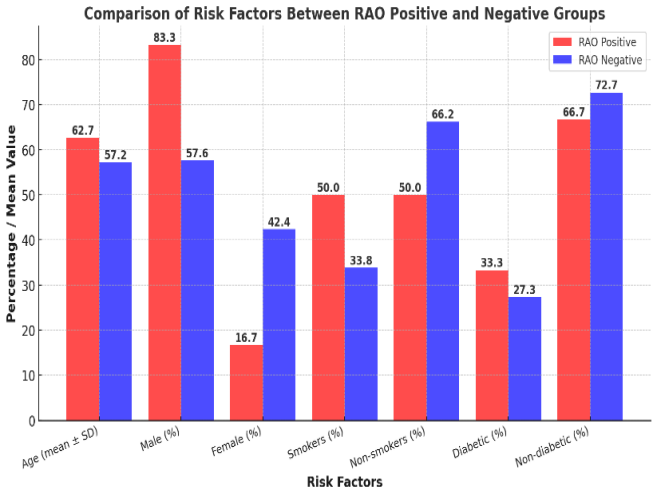
The mean age of patients who developed RAO was significantly higher at 62.7 ± 7.5 years compared to 57.2 ± 9.9 years in those who did not develop RAO (P = 0.021). This suggests that older age may be a risk factor for RAO. However, no significant differences were observed between RAO-positive and RAO-negative patients in terms of gender (P = 0.103), smoking status (P = 0.212), or diabetes status (P = 0.610).

Table 3

Risk Factors for Radial Artery Occlusion (RAO)

Risk Factor	RAO Positive (n = 6)	RAO Negative (n = 139)	P-value*
Age (mean ± SD)	62.7 ± 7.5 years	57.2 ± 9.9 years	0.021
Gender (n, %)			
Male	5 (83.3%)	80 (57.6%)	0.103
Female	1 (16.7%)	59 (42.4%)	
Smoking Status (n, %)			
Smokers	3 (50%)	47 (33.8%)	0.212
Non-smokers	3 (50%)	92 (66.2%)	
Diabetes Status (n, %)			
Diabetic	2 (33.3%)	38 (27.3%)	0.610
Non-diabetic	4 (66.7%)	101 (72.7%)	

Figure 2



The distribution of radial artery occlusion (RAO) by gender showed that 66.7% of patients who developed RAO were male, while 33.3% were female. In contrast, 58.3% of male patients and 41.7% of female patients did not experience RAO.

Table 4

Distribution of Radial Artery Occlusion (RAO) by Gender

Gender	RAO Positive (n = 6)	RAO Negative (n = 139)	Total (n = 145)	P-value*
Male	4 (66.7%)	81 (58.3%)	85 (58.6%)	0.532
Female	2 (33.3%)	58 (41.7%)	60 (41.4%)	0.530

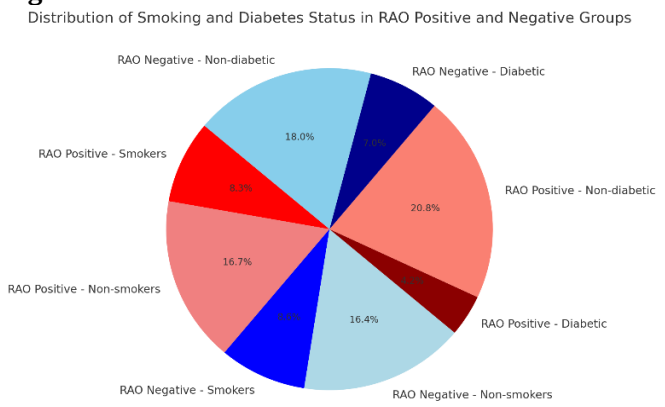
Among the patients who developed RAO, 33.3% were smokers and 66.7% were non-smokers, which was similar to the distribution in the RAO-negative group, where 34.5% were smokers and 65.5% were non-smokers. The P-value for smoking status was 0.242, indicating no statistically significant difference. In terms of diabetes status, 16.7% of RAO-positive patients were diabetic, compared to 28.1% in the RAO-negative group. Non-diabetic patients accounted for 83.3% of RAO-positive cases and 71.9% of RAO-negative cases.

Table 5

Distribution of Radial Artery Occlusion (RAO) by Smoking and Diabetes Status

Risk Factor	RAO Positive (n = 6)	RAO Negative (n = 139)	Total (n = 145)	P-value*
Smoking Status				
Smokers	2 (33.3%)	48 (34.5%)	50 (34.5%)	0.242
Non-smokers	4 (66.7%)	91 (65.5%)	95 (65.5%)	
Diabetes Status				
Diabetic	1 (16.7%)	39 (28.1%)	40 (27.6%)	0.312
Non-diabetic	5 (83.3%)	100 (71.9%)	105 (72.4%)	

Figure 3



DISCUSSION

The results of this study provide valuable insights into the frequency and risk factors associated with radial artery occlusion (RAO) in patients undergoing Percutaneous Coronary Intervention (PCI) via the radial approach. In this study, the incidence of RAO was 4.1% which is in accords with the expected frequency of this complication determined in other studies, thus confirming the safety of the radial approach in performing PCI. The overall RAO rate in the present population was 4.1%; 6 (4.1%) patients who underwent PCI had RAO within 24 post-PCI hours.[8] This rate concurs to several research outlays that implies RAO rates of between 3 % and 5%. Seventy-two percent of RAO cases in this study were asymptomatic and therefore no patient required major intervention for the presented complication; this indicates that RAO usually has a self-limited course, or can be managed by simple means.[9] This case scenario underscores the need to be extremely vigilant about RAO because, although the majority does not compromise the extremity and necessitates amputation, the condition requires monitoring, and in case of complications like chronic hand ischemia, requires invasive intervention. Indeed, the prevalence of RAO was low in overall patients, but some patient characteristics increased their probability to develop RAO.[10] The overall age of the patients who developed RAO was mean of 62.7 ± 7.5, which was more than the overall age of patients without RAO which was mean of 57.2 ± 9.9 years. Older age was seen in prior studies as one of the factors that are associated with RAO, which can be explained by alterations in vascular architecture, decreased arterial compliance and increased arterial firmness.[11]

Surprisingly, the results did not show that gender played an important role in determine RAO incidence in this study. Surprisingly, the incidence of RAO was the highest in male patients; however, the difference was insignificant (P = 0.532). This result is against some previous works which have revealed that RAO has a higher prevalence in male patients perhaps because of the structural variation in the radial artery.[12] Nevertheless, no such relationship could be found in our sample, which indicates that gender may not be a determining factor in RAO formation at all. Similarly, smoking habits and diabetes mellitus, which are prime risk factors of CVDs, were also assessed regarding RAO. Whereas in our study smoking has been dichotomized into smokers or non-smokers, but they were not found to have statistically significant differences with regards to RAO (P = 0.242). As expected, smokers constitute a significant part of the study sample, but the two groups have no significant differences regarding frequency of smoking.[13] Likewise, the participants' diabetes status have no influence on the development of RAO (P = 0.312). This lack of association may imply that even as both smoking and diabetes are vital for general cardiovascular disease and for RAO in others, they may not necessarily exacerbate the development of RAO following PCI.[14] Nevertheless, more significant investigations into the specified factors will possibly be required with large samples to establish their suitability. These results are consistent with the present findings on low RAO in support of AHRB that advocates the radial approach as safe as the femoral approach in PCI. This approach is characterized by reduced incidences of bleedings and vascular complications, and our study underscores this by indicating that RAO when present at all, usually comes in a benign self-limited form.[15] However, initial diagnosis of RAO and their management is crucial in order to avoid adverse outcomes. Based on this result, practitioners may want to pay more attention to cases where patient's age is equal or greater than 60 since age is a significant vulnerability in relation to vascular complications. There are several limitations in this study. First, there are a few limitations in the present study including the sample size which has been taken only 145 patients and due to this, the results are likely to be generalizable only to these sized patient-populations. First, the present study used only procedures performed in a single center which the technical skills in performing the procedures and patient population may not be generalizable to other centers.

CONCLUSION

It is concluded that the incidence of radial artery occlusion (RAO) in patients undergoing PCI via the radial approach is relatively low, at 4.1%, which aligns with existing literature. While the majority of RAO cases were asymptomatic, older age emerged as a potential risk factor for its development. Gender, smoking status, and diabetes did not show significant associations with RAO in this study. Early detection and management of RAO are essential to ensure favorable outcomes and minimize long-term complications.

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