



Original Research

Predictors of Radial Artery Occlusion in Patients with Coronary Heart Disease Undergoing Coronary Angiography or Percutaneous Coronary Intervention via Transradial Access

Muhammad Yolandi Sumadio^{1*} , Inri Pepayosa Sitepu², Nina Apriyani Harefa² ,
Nova Syafriana² , Fairuz Syarifuddin¹ 

¹Department of Cardiology & Vascular Diseases, Faculty of Medicine, University of Sumatera Utara, Medan, Indonesia.

²Prof. Dr. Chairuddin Panusunan Lubis Hospital, University of Sumatera Utara, Medan, Indonesia.

ARTICLE INFO*Article history:*

Submitted Mar 13th 2025

Reviewed Mar 26th – May 22th 2025

Accepted May 23th 2025

Available online Sep 30th 2025

**Correspondence:*

m.yolandi.sumadio@usu.ac.id

Keywords:

Percutaneous coronary intervention
Radial artery occlusion
Transradial

ABSTRACT

Background: Transradial approach is currently the most recommended access for coronary angiography and percutaneous coronary intervention (PCI). However, the risk of developing radial artery occlusion (RAO) with this approach is not uncommon. This study aims to determine the frequency and predictors of RAO in patients undergoing transradial access. **Material and Methods:** This was a prospective study from January 2021 until December 2023. Participants underwent coronary angiography or PCI via transradial access. Radial artery patency was evaluated before and after the procedure. **Results:** A total of 456 subjects were enrolled for the study. RAO was found in 37 of 456 subjects (8.1%). From the results of the multivariate analysis, it was found that age ($p = 0.012$), number of catheters used ($p = 0.006$), and the incidence of hematoma ($p < 0.001$) were independent predictors of the incidence of RAO. **Conclusion:** RAO is a common complication of transradial access so identification of high-risk patients, prevention efforts and close follow-up must be carried out to maintain a patent radial artery.

Highlights:

1. Older age, multiple catheter use, and post-procedural hematoma were identified as independent predictors of radial artery occlusion in patients undergoing transradial coronary angiography or PCI.
2. Early recognition of high-risk patients and careful procedural management are essential to prevent radial artery occlusion and preserve long-term radial artery patency.

Cite this as:

Sumadio, M. Y., Sitepu, I. P., Harefa, N. A., Syafriana, N., Syarifuddin, F. (2025). Predictors of Radial Artery Occlusion in Patients with Coronary Heart Disease Undergoing Coronary Angiography or Percutaneous Coronary Intervention via Transradial Access. Cardiovascular and Cardiometabolic Journal (CCJ), 6(2), 67-72.

Introduction

The leading cause of death worldwide is coronary heart disease (CHD)^[1]. It was estimated that the mortality rate due to CHD in Indonesia was 12.9% of its total population^[2]. Until now, coronary angiography is still the gold standard examination for diagnosing CHD^[3]. Transradial access has been the technique of choice for diagnostic coronary angiography and percutaneous coronary intervention (PCI). Radial approach is associated with a lower rate of bleeding, morbidity, and mortality compared with femoral access.^[4]

Coronary catheterization with transradial access like other interventional procedures can be accompanied by numerous complications. One of the most frequent complications is radial artery occlusion (RAO), with an incidence between 1% to 30%^[5]. RAO after transradial access frequently results in no clinical symptoms due to the dual circulation of the hand and substantial collateralization via the interosseous arteries^[6]. However, once it has been occluded, the radial artery cannot be used as an access point for future catheterization^[7]. There has been a growing number of procedures that are carried out via the radial approach and because staged coronary intervention techniques also require a patent radial artery, the prevention of RAO is pivotal.^[8]

Considering the importance of this, our study aims to determine the frequency and predictors of RAO in CHD patients who underwent transradial coronary angiography or PCI before being discharged from the hospital.

Material and Methods

This research is a prospective study carried out at Prof. Dr. Chairuddin Panusunan Lubis Hospital involving 456 subjects from January 2021 to December 2023. The inclusion criteria for this study were all CHD patients who underwent transradial coronary angiography or PCI. Exclusion criteria included patients with a history of previous RAO, patients who did not have radial artery patency examined before the procedure, patients who did not have radial artery patency evaluated after coronary angiography or PCI before discharged from the hospital, and missing medical record data.

For each patient who met the inclusion and exclusion criteria, data was then collected regarding basic characteristics, type of catheterization undergone (coronary angiography or PCI), number of catheters used during the procedure, duration of the procedure, method of administration of *unfractionated heparin* (UFH), dose of UFH, and hematoma occurrence. Then evaluation of the radial artery before discharged.

Statistical analysis was done using SPSS. Categorical variables are presented with frequencies (n) and percentages (%). Numerical variables are presented with mark average (mean) and standard deviation for data with normal distribution. Meanwhile, for data that is not normally distributed, numerical variables are presented with the middle value (median) and interquartile range. For numerical data, before carrying out the analysis test, a normality test is first carried out. If the data is normally distributed then the analysis uses the independent T test. Meanwhile, if the data is not normally distributed then the Mann-Whitney test was used. For categorical data, a chi-square test is

carried out. Data analysis was then continued with multivariate analysis using linear regression tests.

Results

This study examined 456 subjects, with an average age of 60 years old and 65.1% of them were male. The type of catheterization performed is almost equal between coronary angiography and PCI, where on average each procedure uses 2 catheters. A total of 37 of 456 subjects (8.1%) experienced RAO based on radial artery palpation examination. Table 1 summarizes the basic characteristics of the subjects.

Table 1. Basic characteristics of subjects

Characteristics	Frequency
Age (years)	60 (30 -81)
Gender (%)	
Male	297 (65.1)
Female	159 (34.9)
BMI (kg/m ²)	25 (19-28)
Catheterization Type (%)	
Coronary angiography	220 (48.2)
PCI	236 (51.8)
Number of Catheters used	2 (1-3)
Procedure duration (minutes)	40 (10-125)
Route of UFH administration (%)	
Intra-arterial/intra-coronary	456 (100)
Intravenous	0 (0)
UFH dosage (iu)	6,000 (2,000-16,000)
Hematome (%)	2 (0.4)
RAO (%)	37 (8.1)

All variables were subjected to bivariate analysis, where several factors were found to be predictors of RAO in CHD patients who underwent coronary

angiography or PCI via radial artery access (Table 2). All variables that were significantly related were then subjected to multivariate analysis (Table 3).

Table 2. Bivariate analysis of predictors of RAO in CHD patients who underwent angiography or PCI via radial artery access

	RAO		p value
	Yes (n=37)	No (n=419)	
Age (years)	64.0 ± 10.1	59.0 ± 9.2	0.002
Gender (%)			
Male	22 (59.5)	275 (65.6)	0.450
Female	15 (40.5)	144 (34.4)	
BMI (kg/m ²)	24.6 ± 1.7	24.6 ± 1.6	0.987
Type of catheterization (%)			
Coronary angiography	12 (32.4)	208 (49.6)	0.045
PCI	25 (67.6)	211 (50.4)	
Number of catheters	2.2 ± 0.8	1.7 ± 0.7	< 0.001
Procedure time (minutes)	44.9 ± 23.4	36.6 ± 23.4	0.027
Route of UFH administration (%)			
Intraarterial/intracoronary	37 (100)	419 (100)	-
Intravenous	0	0	
UFH Dosage (IU)	6621.6 ± 3344.6	5421.2 ± 3477.5	0.048
Hematoma	2 (5.4%)	0 (0)	< 0.001

Table 3. Multivariate analysis of predictors of RAO in CHD patients who underwent angiography or PCI via radial artery access

Variable	R ²	F count	p value
(Constant)			0.557
Age			0.012
Types of Catheterization			0.726
Procedure Time	0.093	7,678	0.721
UFH dosage		(P = 0.000)	0.785
Number of Catheters Used			0.006
Hematoma			< 0.001

Discussion

In this study, it was found that older age was significantly associated with an increased risk of RAO (p value = 0.002). From a systematic review and meta-analysis, it was concluded that age has an association with the incidence of RAO but there appears to be a lot of heterogeneity in the literature.^[9]

Female gender and body mass index (BMI) are predictors of RAO after transradial access based on several studies, but this association was not found in the results of this study.^[4,8,10]

PCI compared with coronary angiography without angioplasty is a strong independent predictor factor in the incidence of RAO after transradial coronary angiography (p value = 0.004), a similar finding was seen in this study.^[4]

The average number of catheters used in the group that experienced RAO was greater than in the group that did not experience occlusion. A similar finding was seen in the study conducted by Sada et al, where a larger number of catheters increased the risk of RAO, 2.2 ± 1.4 vs 1.7 ± 0.9 (p value = 0.032).^[10]

The duration of the transradial access procedure is a predictor of radial artery injury after radial artery access. It was found that a longer duration of catheter sheath retention increased the risk of RAO (p value = 0.001)^[11]. This study concluded similar results with a p value of 0.027.

The mean UFH dose in the group that experienced RAO was significantly higher than the group that did not experience occlusion (p value = 0.048). This is very different from what was found in *The SPIRIT OF ARTEMIS Study*, where it was found that high doses of UFH compared to standard doses, significantly reduced the incidence of early RAO from 8.1% to 3.0%.^[12]

In this study, there was a significant difference in the incidence of hematoma between the two groups. The same thing was found in other studies, where patients with hematoma were a predictor of RAO (p value < 0.001). In another study, local hematomas greater than 5 cm in diameter or bleeding academic research consortium (BARC) type 2 bleeding was found in 22% of patients with RAO compared with only 6% of patients without RAO.^[4]

After carrying out multivariate analysis, it was found that predictors that had a significant effect based on multivariate analysis included age, number of catheters used, and the incidence of hematoma.

Conclusion

Age, number of catheters used, and the incidence of hematoma are independent predictors that influence the incidence of RAO in CHD patients who undergo transradial coronary angiography or PCI. RAO is a common complication of transradial access so identification of high-risk patients, prevention efforts and close follow-up must be carried out to maintain a patent radial artery.

Acknowledgements

The authors of this research have gratitude to all the employees in the catheterization laboratory of Prof. Dr. Chairuddin Panusunan Lubis Hospital who helped and facilitated this work to be achieved.

References

1. Nowbar AN, Gitto M, Howard JP, Francis DP, Al-Lamee R. Mortality From Ischemic Heart Disease: Analysis of Data From the World Health Organization and Coronary Artery Disease Risk Factors From NCD Risk Factor Collaboration. *Circ: Cardiovascular Quality and Outcomes*. 2019 Jun;12(6):e005375.

2. Adam AA, Tiluata LJ, Yunita L, Putra MP, Wilujeng N, Homalessy LV, et al. A Clinical Profile of Acute Coronary Syndrome Patients in Kupang. *IJC*. 2022 Jun 13;42(4):109–18.
3. Beştemir A. Analysis of Coronary Angiography and Revascularization Rates Made Over 5 Years in Public Institutions in Türkiye. *Anatol J Cardiol*. 2023;529–33.
4. Schlosser J, Herrmann L, Böhme T, Bürgelin K, Löffelhardt N, Nührenberg T, et al. Incidence and predictors of radial artery occlusion following transradial coronary angiography: the proRadial trial. *Clin Res Cardiol*. 2023 Sep;112(9):1175–85.
5. Tsigkas G, Papanikolaou A, Apostolos A, Kramvis A, Timpilis F, Latta A, et al. Preventing and Managing Radial Artery Occlusion following Transradial Procedures: Strategies and Considerations. *JCDD*. 2023 Jun 30;10(7):283.
6. Mason PJ, Shah B, Tamis-Holland JE, Bittl JA, Cohen MG, Safirstein J, et al. An Update on Radial Artery Access and Best Practices for Transradial Coronary Angiography and Intervention in Acute Coronary Syndrome: A Scientific Statement From the American Heart Association. *Circ: Cardiovascular Interventions*. 2018 Sep;11(9):e000035.
7. Buturak A, Gorgulu S, Norgaz T, Voyvoda N, Sahingoz Y, Degirmencioglu A, et al. The long-term incidence and predictors of radial artery occlusion following a transradial coronary procedure. *Cardiol J*. 2014 Aug 29;21(4):350–6.
8. Munir U, Khan R, Nazeer N, Akhter J, Hassan AU, Hanif B. Frequency and Predictors of Radial Artery Occlusion in Patients Undergoing Percutaneous Coronary Intervention.
9. Rashid M, Kwok CS, Pancholy S, Chugh S, Kedev SA, Bernat I, et al. Radial Artery Occlusion After Transradial Interventions: A Systematic Review and Meta-Analysis. *JAHA*. 2016 Jan 13;5(1):e002686.
10. Sadaka MA, Etman W, Ahmed W, Kandil S, Eltahan S. Incidence and predictors of radial artery occlusion after transradial coronary catheterization. *Egypt Heart J*. 2019 Dec;71(1):12.
11. Wang J, Yi C, Zhang J. Study on Influencing Factors of Radial Artery Occlusion after Repeated Right Radial Artery Coronary Intervention. Hashmi MF, editor. *Contrast Media & Molecular Imaging*. 2022 Jan;2022(1):9624339.
12. Hahalis GN, Leopoulou M, Tsigkas G, Xanthopoulou I, Patsilnakos S, Patsourakos NG, et al. Multicenter Randomized Evaluation of High Versus Standard Heparin Dose on Incident Radial Arterial Occlusion After Transradial Coronary Angiography. *JACC: Cardiovascular Interventions*. 2018 Nov;11(22):2241–50.