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Incidence of Radial Artery Loss Among Cases After Coronary Angiography

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Author`s Contribution

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ABSTRACT

Objective: To evaluate the incidence of radial artery loss among patients following coronary angiography.

Methodology: A prospective cohort study was carried out at Cardiology Department of PIMS from January 2022 to December 2023. Patients aged 18 years old or above, both genders that were undergoing coronary angiography radial route for various indications in cardiac center at PIMS were included. All patients had radial artery cannulation with 6 French sheath. Patient who had only coronary angiography, their sheaths were removed just after completion of the procedure. Patients who had PCI their sheaths were removed after 4 hours of completion of procedure. Patients who had PCI were loaded with antiplatelet medications. Patients were followed in OPD after 2 to 3weeks. All of the information was entered and analyzed using SPSS version 26.

Results: Mean age of the patients was 56.52+10.69 years. Male were 70.3%, and females were 29.7%. Overall, data indicates that 10.5% of the patients had a non-palpable radial artery after the procedure. There was no significant association found of radial artery loss with age, gender, diabetes, hypertension and smoking history (p=>0.05), however its incidence observed significantly higher among patients who underwent PCI (p-0.001).

Conclusion: The incidence of an asymptomatic complication of radial artery loss observed to be 10.8% among patients undergoing coronary angiography via radial route. However, PCI was noted to be a significant predictor.

Key words: Angiography, PCI, Radial artery loss, incidence.

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Introduction

Coronary artery disease (CAD) continues to be a major health issue, placing significant strain on both individuals and healthcare systems globally. The disease's effects arise from the narrowing and blockage of arteries, which can result in serious complications such as heart attacks and heartfailure.[1] It is responsible for around 610,000 deaths each year (approximately 1 in 4 deaths) and stands as the leading cause of mortality in the United States.[2]

Globally, it ranks as the third leading cause of death, contributing to 17.8 million deaths each year.[2] A significant portion of this burdenaffects low and middle-income countries, resulting in nearly 7 million deaths and 129 million disability-adjusted life years (DALYs) each year.[3] Coronary angiography (CAG) is used to identifythe type and number of affected vessels as well as the degree of stenosis, which are essential factors for determining the appropriate coronary intervention method.[4]

Coronary angiography can be performed through the femoral, radial, or ulnar arteries. Historically,the common femoral artery has been the preferred access site for coronary angiography and angioplasty.[5] However, complications at the vascular access site, such as bleeding, hematoma, arteriovenous fistula, or pseudoaneurysm, are relatively common following transfemoral approach(TFA) procedures.[5,6] Transradial approach provides several benefits, including minimal invasiveness, ease of conducting diagnostic and therapeutic coronary interventions, reduced patient discomfort, early

mobilization, shorter hospital stays, and the lower costs of the Hospital.[7,8]

Despite its many benefits, radial access can have certain disadvantages, including pain or vascular complications. Persistent occlusion of the radial artery is the primary complication of this approach.[9,10] Most patients remain asymptomatic because of collateral arterial perfusion, leading to under diagnosis in routine clinical practice. However, silent radial occlusion presents a significant challenge for future angiographies.[9] Following Transradial coronary intervention(TCI), early radial artery occlusion (RAO) can occur due to radial artery spasm and thrombosis. This may be triggered by the combined effects of catheter-induced endothelial injury and reducedblood flow after the insertion of the sheath and catheter.[7,11]

In initial studies, the rate of radial artery occlusion after angiography ranged from less than 1% to as high as 33%.[12,13] Recent data indicate that the average incidence remains above 4%.[9] Despite these findings, there is a lack of precise data on the incidence of RAO at the local level. This studyaims to evaluate the incidence of radial artery occlusion among patients following coronary angiography. The results of this study could contribute to a better understanding of radial artery loss rates in our specific population, inform clinical practices, and potentially lead to the development of strategies to minimize this complication.

Methodology

A prospective cohort study was carried out at Cardiology Department of PIMS. Study was done after taking ethical approval from ethical review committee during a period of two years from January 2022 to December 2023. Patients aged 18 years old or above, both gender who were undergoing coronary angiography radial route for various indications in cardiac center at PIMS were included. Patients with history of preexisting radial artery occlusion, failed attempt at coronary angiography from radial route, post CABG patients, patients undergoing angiography via alternative route, patients who did not attend follow-up appointments and those who were not willing to take a part of study were excluded. Detailed demographic information, medical historyand clinical examination were done. An informed consent was taken from each case after explaining the purpose of the study. The angiography process was documented, including the measurement of the sheath, the time frame of the procedure, and any issues that occurred. All patients had radial artery cannulation with 6 French sheath. Patient who had only coronary angiography, their sheaths were removed just after completion of the procedure. Patients who hadPCI their sheaths were removed after 4 hours of completion of procedure. All patients were given 100 mcg of nitroglycerine and 5000 units of UFH. Additional heparin of 5000 units was given to those who underwent PCI.

Patients who had PCI were loaded with antiplatelet medications. Participants were monitored after the procedure for evidence of radial artery loss. Patients were followed in OPD after 2 to 3weeks. Outcome for the incidence of RAO, was defined as the lack of a palpable radial pulse and verified by Doppler ultrasound at during follow up. All of the information was entered and analyzed using SPSS version 26. Stratification with respect to the effect modifiers like age and gender was done, by applying chi-square test and a p-value ≤ 0.05 was taken as significant.

Results

Mean age of the patients was 56.52 ± 10.69 years. The majority of the patients were male 70.3%, and 29.7% being female. Family history of coronary artery disease (CAD) was positive in 38.9% patients. 36.8% patients were diabetics, and 36.8% were hypertensive. According to smoking history 8.2% patients were current smokers and 6.4% were ex-smokers. Although 29.3% of the patients had a previous history of angiography. Table I

Table I: Demographic and clinical information of the patients. (n=563)

Variables	N	%
Gender		
Male	396	70.3%
Female	167	29.7%
Total	563	100.0%
Family history of CAD		
Positive	219	38.9%
Negative	344	61.1%
Total	563	100.0%
Diabetes mellitus		
Yes	207	36.8%
No	356	63.2%
Total	563	100.0%
Hypertension		
Yes	207	36.8%
No	356	63.2%
Total	563	100.0%
Smoking history		
Yes	46	8.2
No	481	85.4
Ex- smoker	36	6.4
Total	563	100.0
Previous history of angiography		
Yes	165	29.3
No	398	70.7
Total	563	100.0

According to the status of radial artery loss following the procedure for an overall sample of 563 individuals, 59 (10.5%) individuals found with the loss where the radial artery was not palpable, while the radial artery remained palpable in 504(89.5%) of the cases. Figure 1

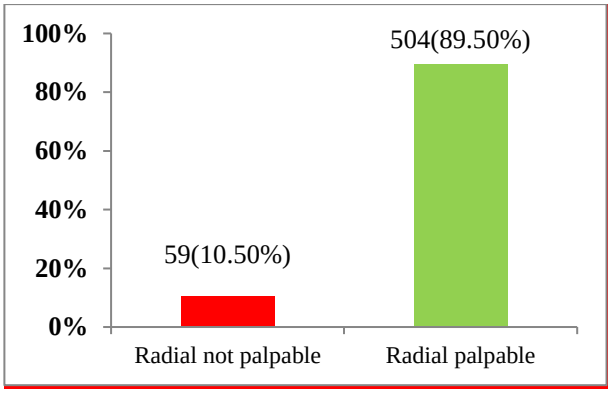

Figure 1. Radial artery loss status after procedure. (n=563)

Table II: Stratification for radial artery loss with respect to effect modifiers. (n=563)

Variables		Radial artery loss			p-value
		Yes	No	Total	
Age groups	25-40 years	4	36	40	0.268
		0.7%	6.4%	7.1%	
	41-50 years	14	121	135	
		2.5%	21.5	24.0%	
	51-60 years	26	156	182	
		4.6%	27.7	32.3%	
	61-70 years	10	137	147	
		1.8%	24.3	26.1%	
	>70 years	5	54	59	
		0.9%	9.6%	10.5%	
Gender	Male	41	355	396	0.880
		7.3%	63.1	70.3%	
	Female	18	149	167	
		3.2%	26.5	29.7%	
Diabetes mellitus	Yes	25	182	207	0.345
		4.4%	32.3	36.8%	
	No	34	322	356	
		6.0%	57.2	63.2%	
Hypertension	Yes	35	291	326	0.816
		6.2%	51.7	57.9%	
	No	24	213	237	
		4.3%	37.8	42.1%	
Smoking history	Current smoker	5	41	46	0.908
		0.9%	7.3%	8.2%	
	Ex-smoker	51	430	481	
		9.1%	76.4	85.4%	
	No	51	430	481	
		9.1%	76.4	85.4%	
Previous Angiography	Yes	15	150	165	0.489
		2.7%	26.6	29.3%	
	No	44	354	398	
		7.8%	62.9	70.7%	
PCI	Yes	38	185	223	0.001
		6.7%	32.9	39.6%	
	No	21	319	340	
		3.7%	56.7	60.4%	

There was no significant association found of radial artery loss with age, gender, diabetes, hypertension and smoking history (p=>0.05), however its incidence observed significantly higher among patients who underwent PCI (p-0.001), as shown in Table II.

Discussion

Transradial access is now widely favored as the primary approach for coronary procedures, including coronary angiography and PCI.[10] Radial artery occlusion (RAO) is regarded as the most prevalent and severe complication associated TRA. This study was conducted on 563 cases undergoing angiography, with an overall mean age of 56.52 ± 10.69 years. The majority of the patients were male (70.3%), with 29.7% being female, to evaluate the incidence of radial artery occlusion among patients following coronary angiography. In alignment with this study, Sadaka MA et al[5] reported an average age of 57.7 ± 8.8 years, with 104 male patients (63.4%) and 60 female patients (36.6%). Similarly, the study by Didagelos M et al[10] involved 1,357 patients, with a mean age of 64.8 ± 11.7 years, of which 24.9% were female. The male predominance in these studies may be due to various factors including smoking habits, alcohol consumption and hormonal factors.

Radial artery occlusion (RAO) stands as the most prevalent and notable complication following transradial catheterization. The incidence of RAO varies widely, ranging from 1% to 10%.[11] In this study, according to the status of radial artery loss following the procedure for an overall sample of 563 individuals, 59 (10.5%) individuals experienced a loss where the radial artery was not palpable. This incidence is markedly lower compared to Sadaka MA et al[5] who reported that after six months, RAO was identified in 49 patients (29.9%). On the other hand, Schlosser J et al[9] reported a lower incidence of RAO at 4.6%. Similarly, Xu D et al[15] found the overall incidence of post-radial artery occlusion (PRAO) to be 9.1%. Dwivedi SK et al[7] demonstrated that RAO was diagnosed in 11.97% of the patients. Bukhari SN et al[16] also found a lower incidence of RAO after 24 hours, affecting 5 patients (4.0%). Ahmad F et al[17] also found overall lower incidence of RAO in (5.3%) of the cases and notably, patients over the age of 60 experienced a significantly higher onset of RAO. However, the findings of et al[18] were consistent with our study's primary outcome, with RAO observed in 11.3% in the patients of in their study.

Above differences in the incidence of RAO across these studies may due to several factors, including variations in

procedural techniques, difference in sample size of the studies and in follow-up- assessment duration, patient demographics, follow-up duration, and criteria for diagnosing RAO. Differences in post-procedural care and the use of preventive measures such as anticoagulants or vasodilators may also play a role in the variability of RAO rates.

Furthermore, in this study there was no significant association found of radial artery loss with age, gender, diabetes, hypertension and smoking history (p=>0.05), however its incidence observed significantly higher among patients who underwent PCI (p-0.001). Inconsistently Schlosser J et al[9] found most significant independent predictors of radial occlusion were being female and active status of smoking.[9] The limitations of this study include a relatively small sample size and a lack of long-term follow-up, which may affect the generalizability of the findings. Moreover, the study did not account for other potential confounding factors that could influence RAO incidence. Further studies recommended with more diverse populations and include longer follow-up periods to better understand the long-term risks of RAO. Additionally, it is suggested that to investigate the impact of different procedural techniques and post-procedural care protocols on RAO rates.

Conclusion

As per the study findings the incidence of a asymptomatic complication of radial artery loss observed to the 10.8% among patients undergoing coronary angiography via radial route. The results indicated that the demographic and common clinical characteristics are not predictive of radial artery loss. However, PCI was noted to be a significant predictor. This emphasizes the importance of carefully considering and monitoring radial artery integrity, particularly among patients undergoing PCI, to reduce risks and improve patient outcomes after coronary angiography. Further research is needed to explore ways to reduce radial artery complications in this specific group of patients.

References

1. Bansal A, Hiwale K. Updates in the management of coronary artery disease: a review article. *Cureus*. 2023 Dec;15(12): 50644 https://doi.org/10.7759/cureus.50644
2. Brown JC, Gerhardt TE, Kwon E. Risk factors for coronary artery disease. *StatPearls [Internet]*. Treasure Island (FL): StatPearls Publishing; 2024 Jan. PMID: 32119297.
3. Ralapanawa U, Sivakanesan R. Epidemiology and the magnitude of coronary artery disease and acute coronary syndrome: a narrative review. *J Epidemiol Glob Health*. 2021;11(2):169-77. https://doi.org/10.2991/jegh.k.201217.001
4. Meda JR, Kusima HL, Magitta NW. Angiographic characteristics of coronary artery disease in patients undergoing diagnostic coronary angiography at a tertiary hospital in Tanzania. *BMC Cardiovasc Disord*. 2024;24(1):125. https://doi.org/10.1186/s12872-024-03773-7
5. 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;71:1-9. https://doi.org/10.1186/s43044-019-0008-0
6. Sciahbasi A, Pristipino C, Ambrosio G. Arterial access-site-related outcomes of patients undergoing invasive coronary procedures for acute coronary syndromes (from the ComPaRison of Early Invasive and Conservative Treatment in Patients with Non-ST-ElevatiOn Acute Coronary Syndromes [PRESTO-ACS] Vascular Substudy). *Am J Cardiol*. 2009;103(6):796-800. https://doi.org/10.1016/j.amjcard.2008.11.049
7. Dwivedi SK, Sharma AK, Nayak GR, Chaudhary GK, Chandra S, Pradhan A, et al. Factors influencing radial artery occlusion after transradial coronary intervention in the Indian population. *Anatol J Cardiol*. 2022;26(2):105. https://doi.org/10.5152/AnatolJCardiol.2021.163
8. Mattea V, Salomon C, Menck N, Lauten P, Malur FM, Schade A, et al. Low rate of access site complications after transradial coronary catheterization: a prospective ultrasound study. *Int J Cardiol Heart Vasc*. 2017;14:46-52. https://doi.org/10.1016/j.ijcha.2016.12.003
9. 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;112(9):1175-85. https://doi.org/10.1007/s00392-022-02094-z
10. Bernat I, Aminian A, Pancholy S, Mamas M, Gaudino M, Nolan J, et al. Best practices for the prevention of radial artery occlusion after transradial diagnostic angiography and intervention: an international consensus paper. *JACC Cardiovasc Interv*. 2019;12(22):2235-46. https://doi.org/10.1016/j.jcin.2019.07.043
11. Avdikos G, Karatasakis A, Tsoumeleas A, Lazaris E, Ziakas A, Koutouzis M. Radial artery occlusion after transradial coronary catheterization. *Cardiovasc*

Diagn Ther. 2017;7(3):305-16. https://doi.org/10.21037/cdt.2017.03.14

12. Rougé A, Faurie B, Abdellaoui M, Monségu J. Patent hemostasis impact in clinical routine: large monocentric echo-Doppler study of radial artery patency after coronary catheterization. *J Invasive Cardiol*. 2021;33(2):
13. Uhlemann M, Möbius-Winkler S, Mende M, Eitel I, Fuernau G, Sandri M, et al. The Leipzig prospective vascular ultrasound registry in radial artery catheterization: impact of sheath size on vascular complications. *JACC Cardiovasc Interv*. 2012;5(1):36-43. https://doi.org/10.1016/j.jcin.2011.08.011
14. Didagelos M, Pagiantza A, Papazoglou AS, Moysidis DV, Petroglou D, Daios S. Incidence and prognostic factors of radial artery occlusion in transradial coronary catheterization. *J Clin Med*. 2024;13(11):3276. https://doi.org/10.3390/jcm13113276
15. Xu D, Liu Y, Xu C, Liu X, Chen Y, Feng C, et al. Factors affecting radial artery occlusion after right transradial artery catheterization for coronary intervention and procedures. *Ther Clin Risk Manag*. 2023;19:525-33. https://doi.org/10.2147/TCRM.S403410
16. Bukhari SN, Javed I, Usman M. Incidence of radial artery occlusion in patients undergoing percutaneous coronary intervention via transradial access. *Pak J Med Sci*. 2023;39(2):377-82. https://doi.org/10.12669/pjms.39.2.7219
17. Ahmad F, Ullah I, Khan SW. Radial artery occlusion after transradial access for coronary interventions. *Cureus*. 2024;16(4): e58036 https://doi.org/10.7759/cureus.58036
18. Munir U, Khan R, Nazeer N, Akhter J, ul Hassan A, Hanif B. Frequency and predictors of radial artery occlusion in patients undergoing percutaneous coronary intervention. *Cureus*. 2022;14(5): e25505 https://doi.org/10.7759/cureus.25505