The Journal of Teachers Association
ISSN 1019-8555 (Print) & ISSN 2408-8854 (Online)
Frequency: Bi-Annual
DOI: https://doi.org/10.70818/taj.v037i02.0390

OPEN ACCESS
Website: www.tajrmc.com
Email: editor@tajrmc.com
Volume-37 | Issue-1 | Jan-Jun 2024

Radial Artery Spasm in Transradial PCI: Risk Factors and Protective Role of the Combo Technique

Md. Mamunur Rahman*[1], Mir Jamal Uddin[2], Abdul Momen[3], Tasnoma Siddiquee[4], Md. Ahasanul Haque Razib[1], Mohammad Ataullah[1], Mohammad Abdul Gaffar[5], Md. Afjal Hossain[6]

[1] Department of Cardiology, Mymensingh Medical College Hospital, Mymensingh
[2] Department of Cardiology, Bangladesh Specialized Hospital, Dhaka
[3] Department of Cardiology, National Institute of Cardiovascular Disease and Hospital, Dhaka
[4] Department of Anatomy, Mymemsingh Medical College Hospital, Mymensingh
[5] Junior Consultant, National Institute of Cardiovascular Disease and Hospital, Dhaka
[6] Assistant Registrar, Sher-E-Bangla Medical College Hospital, Barisal

Abstract: ***Background:*** Transradial percutaneous coronary intervention (PCI) has gained widespread acceptance due to its lower bleeding complications, improved patient comfort, and quicker ambulation compared to the transfemoral approach. However, one of the notable challenges during transradial access is radial artery spasm (RAS), which can lead to procedural difficulty, patient discomfort, and even access site failure. This study aims to identify the risk factors associated with radial artery spasm during trans-radial PCI and evaluate the protective role of the Combo technique compared to the conventional 6Fr catheter approach. ***Methods:*** This cross-sectional observational study was carried out in the Department of Cardiology at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh, from July 2020 to June 2021. Study subjects were divided into two groups, Group I: Transradial PCI using —the Combo technique, and Group II: Transradial PCI using the conventional 6 Fr guide catheter technique, and in each group, 64 patients were included. Data were analyzed using SPSS (Statistical Package for Social Sciences) Version 24.0. ***Result:*** In this study involving 128 patients undergoing trans-radial PCI, no significant differences were observed between the Combo technique group (Group I) and the conventional 6Fr group (Group II) in terms of age, gender, clinical diagnosis, or traditional cardiovascular risk factors such as hypertension, diabetes, dyslipidemia, smoking, or family history of CAD. However, multivariate regression analysis identified the Combo technique as an independent protective factor against radial artery spasm (OR 0.312, 95% CI 0.118–0.826, p=0.019). ***Conclusion:*** This study underscores that while traditional cardiovascular risk factors such as hypertension, diabetes, smoking, dyslipidemia, and prior myocardial infarction did not significantly predict the occurrence of radial artery spasm (RAS) during transradial percutaneous coronary intervention (PCI), the use of the Combo technique emerged as an independent protective factor.

Keywords: Radial Artery Spasm, Transradial PCI, Combo Technique, Coronary Artery Disease.

Original Research Article

Correspondence:
Dr. Md. Mamunur Rahman
Department of Cardiology, Mymensingh Medical College Hospital, Mymensingh, Bangladesh
Email: mamun_m37@yahoo.com

How to cite this article:
Rahman MM, Uddin MJ, Momen A, Siddiquee T, Razib MAH, Ataullah M, Gaffar MA, Hossain MA; Radial Artery Spasm in Transradial PCI: Risk Factors and Protective Role of the Combo Technique. Taj 2024;37 (1): 313-319

Article history:
Received: Mar 01, 2024
Published: Jun 30, 2024

INTRODUCTION

Percutaneous coronary intervention (PCI) has evolved significantly over the last few decades, with the transradial approach (TRA) emerging as a preferred access site due to its lower complication rates and improved patient outcomes compared to transfemoral access.[1, 2] Among the recognized advantages of TRA are reduced bleeding complications, early ambulation, enhanced patient comfort, and shorter hospital stays, making it especially favorable in both elective and emergency

settings.[3] Despite these benefits, the radial artery presents its own set of challenges, most notably radial artery spasm (RAS), which remains one of the most frequent and troublesome complications of TRA, affecting procedural success and patient comfort.[4] RAS is characterized by transient narrowing or contraction of the radial artery in response to mechanical or chemical stimuli during catheter manipulation, sheath insertion, or angiographic contrast exposure.[5] Its incidence has been reported to vary between 4% and 20%, depending on patient characteristics, procedural techniques, and the use of vasodilators or hydrophilic sheaths.[6] The clinical manifestations of RAS range from pain and resistance to catheter advancement to more severe outcomes such as procedural failure or radial artery occlusion (4). Several patient- and procedure-related factors have been implicated in the development of RAS. Among them, female gender, low body mass index, diabetes mellitus, hypertension, and smoking have been consistently reported as patient-related risk factors.[7]

Procedure-related factors include the use of larger sheath sizes, prolonged catheterization time, multiple catheter exchanges, and operator experience.[8] The anatomical characteristics of the radial artery, such as smaller diameter and higher susceptibility to vasomotor response, further contribute to the spasm, particularly in elderly or female patients.[9] In recent years, attention has shifted toward device-based strategies, such as the introduction of hydrophilic-coated sheaths and smaller-caliber catheters to reduce trauma to the vascular endothelium.[10] One such strategy is the "Combo technique," which combines features of sheathless techniques with hydrophilic coatings to minimize arterial irritation and improve procedural ease. The Combo technique involves the use of a sheathless guiding catheter system that effectively reduces the outer diameter of the access device while maintaining the inner lumen necessary for interventional tools. By decreasing radial artery wall contact and minimizing friction during catheter advancement, this method theoretically reduces the likelihood of spasms and improves overall success rates.[11] Several studies have supported the safety and efficacy of this approach, suggesting a lower incidence of RAS and comparable or improved procedural outcomes compared to the conventional 6Fr sheath-guided catheter system.[12] Despite the accumulating evidence supporting the role of the Combo technique, few studies have systematically examined its protective effect against RAS, particularly in comparison with conventional techniques. Moreover, there is limited literature from resource-limited settings where optimizing procedural safety is particularly vital. Understanding the interplay between demographic and clinical risk factors and procedural approaches can guide tailored strategies to minimize complications and enhance patient outcomes. This study aims to identify the risk factors associated with radial artery spasm during transradial PCI and evaluate the protective role of the Combo technique compared to the conventional 6Fr catheter approach.

METHODS

This cross-sectional observational study was carried out in the Department of Cardiology at the National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh, from July 2020 to June 2021. Based on inclusion and exclusion criteria, patients of ischaemic heart disease admitted into NICVD undergoing coronary angiogram followed by ad-hoc PCI or patients admitted for direct PCI (CAG done previously through trans-radial approach) were included in the study population. The sample was collected by purposive sampling method. Study subjects were divided into two groups, Group I: Transradial PCI using —the Combo technique, and Group II: Transradial PCI using the conventional 6 Fr guide catheter technique, and in each group, 64 patients were included. The study protocol was approved by the Ethical Review Committee of NICVD. Informed written consent was taken from each patient or near relatives. Data was collected and compiled duly in a pre-designed data collection sheet for statistical analysis and interpretation. Data from the study were processed and analyzed both manually and using SPSS (Statistical Package for Social Sciences) Version 24.0. Quantitative data were presented as mean and standard deviation, with comparisons performed using the Z-test and Student's t-test, as appropriate. Qualitative data were expressed as frequency and percentage, and comparisons between groups were made using the

chi-square (χ^2) test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Comparison of the Study Groups According to Their Age (n=128)

Age (in years)	Group-I (n=64)		Group II (n=64)		*p*-value
	N	%	n	%	
≤40	4	6.3	7	10.9	
41-50	21	32.8	24	37.5	
51-60	29	45.3	23	35.9	
61-70	10	15.6	10	15.6	
Mean ± SD	52.60 ±7.3		51.89 ±8.5		0.608^{ns}

Group I- Combo technique group
Group II – Conventional 6Fr group

Independent sample t-test
ns – non-significant

Table 1 shows a comparison of the study group according to age distribution. The highest frequency was 51-60 years age, 29 and 23 in group I and group II, respectively and that is followed by 41- 50 years age. The mean ± SD of group I and group II was 52.60 ±7.3 years and 51.89 ±8.5 years, but this difference was not statistically significant (p=0.608).

Table 2: Distribution of Patients by Gender and Study Group (n=128)

Gender	Group I	Group II	Total
Male	58	57	115
Female	6	7	13
Total	64	64	128

Table 2 shows, that among the 115 male patients, 58 belong to Group I and 57 to Group II. In the female group, 6 patients belonged to Group I, whereas 7 were to Group II.

Table 3: Comparison of Underlying Diagnosis of Studied Groups(n=128)

Diagnosis	Group-I (n=64)		Group-II (n=64)		*p*-value
	n	%	n	%	
Unstable angina	14	21.9	15	23.4	0.857^{ns}
NSTEMI	24	37.5	21	32.8	
STEMI	26	40.6	28	43.8	

Group I- Combo technique group
Group II – Conventional 6Fr group

Chi-square test ns – non-significant

Table 3 shows a comparison of the underlying diagnosis of the patients undergoing PCI in studied groups, STEMI occurred in almost half of the patients, in group I 26 patients, and in group II, 28 patients. NSTEMI comprised 24 patients in group I and 21 patients in group II and there was no significant difference between this group (p=0.857).

Table 4: Comparison of the Study Groups According to Their Risk Factors (n=128)

Cardiac risk factor profiles	Group-I (n=64)	Group-II (n=64)	*p*-value

	n	%	n	%	
Hypertension	48	75	47	73.4	1.00[ns]
Diabetes mellitus	26	40.6	23	35.9	0.716 [ns]
Dyslipidaemia	29	45.3	37	57.8	0.216 [ns]
Smoking	27	42.2	29	45.3	0.859 [ns]
Family history of CAD	20	31.3	14	21.9	0.317 [ns]

Group I- Combo technique group
Group II – Conventional 6Fr group
Chi-square test ns – non-significant

Table 4 showed in group I, 48 (75 %) patients were hypertensive, whereas 47 (73.5%) patients in group II, and this difference was not statistically significant (p=1.00). For DM, no significant difference (p=0.716) existed between group I and group II (40.6% vs 35.9%). 29 (45.3%) patients in group I and 37 (57.8%) patients in group II were dyslipidaemic, and this difference was not statistically significant (p=0.216). Again, no significant difference was present in smoking and family history of CAD among these two groups, p-value 0.859 and 0.317 respectively. Overall, there was no significant difference present in traditional cardiovascular risk factors between these two groups.

Table 5: Multivariant Regression Analysis of Risk Factor for Radial Artery Spasm

Risk factors	B	Std. Error	OR	95% Confidence Interval for OR		p-value
Male Sex	-1.095	0.829	0.334	0.066	1.698	0.186
Smoking	-.004	0.499	0.996	0.375	2.646	0.993
HTN	.732	0.632	2.080	0.602	7.184	0.247
DM	-.189	0.507	0.828	0.306	2.238	0.710
Dyslipidaemia	-.146	0.518	0.864	0.313	2.383	0.778
P/H of MI	.629	0.564	1.876	0.621	5.670	0.265
Combo technique	-1.164	0.496	0.312	0.118	0.826	0.019
Age>60 years	.293	0.294	1.340	0.753	2.386	0.320

Table 5 shows a multivariant regression analysis of the risk factor of radial artery spasm. The combo technique was found to be an independent protective factor (OR 0.312, 95% CI 0.118-0.826, p =0.019). Other risk factors were not statistically significant in multivariant regression analysis.

DISCUSSION

Radial artery spasm (RAS) is a notable complication of transradial percutaneous coronary intervention (PCI), causing patient discomfort, procedural delay, and technical difficulties. This study aimed to identify risk factors for RAS and assess whether the Combo technique offers protection compared to the conventional 6Fr approach. Our results show that age and gender distributions were similar between the Combo technique group (Group I) and the conventional group (Group II), with no statistically significant differences. Most patients in both groups were in the 51–60 age bracket, with a male predominance of nearly 90%. This aligns with findings from Adamo *et al*., who also reported a majority of trans-radial PCI cases being performed in middle-aged males, with lower representation of female patients, despite the higher RAS risk in women due to smaller artery caliber and greater vascular reactivity.[13]

The clinical presentation of patients—STEMI being the most frequent indication—was also similar between groups, which is consistent with Bernat *et al*., who noted that STEMI was a leading cause of emergency transradial PCI

procedures.[14] The analysis of traditional cardiovascular risk factors—hypertension, diabetes, dyslipidemia, smoking, and family history of CAD—revealed no statistically significant differences between the groups. These results are comparable to the observations of Gorgulu *et al*., who also found no significant association between these risk factors and the incidence of RAS in their patient population.[15] The key finding in our study is that the Combo technique significantly reduced the risk of RAS, as shown in the multivariate regression analysis (OR 0.312, 95% CI 0.118–0.826, p = 0.019). This supports the growing body of evidence suggesting that procedural techniques—particularly sheathless systems and tapered dilators—play a major role in mitigating RAS. Kiemeneij *et al*., showed that the use of hydrophilic sheaths and the administration of vasodilators decreased RAS incidence.[16] Similarly, Isawa *et al*., reported that the sheathless guiding catheter technique reduced procedural complications and improved outcomes in complex cases, echoing our study's conclusion that the Combo technique is beneficial.[17] Moreover, Bertrand *et al*., highlighted that smaller or tapered catheters reduce radial artery trauma and thereby lower the chance of spasm, which corresponds well with the rationale for using the Combo approach.[8] While our regression analysis examined multiple risk factors (e.g., sex, smoking, diabetes), none aside from the technique used reached statistical significance. Although another author reported that smoking and female sex may predispose to RAS, our findings did not corroborate these associations, possibly due to our study's predominantly male cohort and small female sample size.[18]

Likewise, Saito *et al*., found younger age to be a risk factor due to increased arterial tone, a relationship that was not statistically evident in our population.[9] Pharmacological prophylaxis remains a cornerstone in preventing RAS, often using intra-arterial nitroglycerin and verapamil. However, as Agostoni *et al*. emphasized, mechanical strategies (e.g., smaller sheaths, hydrophilic coating) are just as critical.[19] Our study strengthens this viewpoint by demonstrating that mechanical technique—specifically, the Combo approach—can independently reduce RAS risk even in the presence of traditional risk factors. Our findings align with the "radial paradox" described by Rao *et al*., where although transradial PCI is associated with lower bleeding and access-site complications, it presents unique technical hurdles like RAS, especially when conventional larger sheaths are used.[20]

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study underscores that while traditional cardiovascular risk factors such as hypertension, diabetes, smoking, dyslipidemia, and prior myocardial infarction did not significantly predict the occurrence of radial artery spasm (RAS) during transradial percutaneous coronary intervention (PCI), the use of the Combo technique emerged as an independent protective factor. The significantly lower incidence of RAS in the Combo technique group highlights its clinical utility in enhancing procedural safety and patient comfort.

Recommendation

Based on the findings, it is recommended that the Combo technique be routinely considered in transradial PCI procedures to reduce the incidence of radial artery spasm. Further multicenter studies with larger populations are suggested to validate its protective role and establish standardized protocols for its implementation in diverse clinical settings.

Funding: No funding sources
Conflict of interest: None declared

REFERENCES

1. Rao SV, Cohen MG, Kandzari DE, Bertrand OF, Gilchrist IC. The Transradial Approach to Percutaneous Coronary Intervention. Journal of the American College of Cardiology. 2010 May;55(20):2187–95.
2. 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.

3. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenza G, et al. Radial Versus Femoral Randomized Investigation in ST-Segment Elevation Acute Coronary Syndrome. Journal of the American College of Cardiology. 2012 Dec;60(24):2481–9.
4. Sandoval Y, Bell MR, Gulati R. Transradial Artery Access Complications. Circ: Cardiovascular Interventions. 2019 Nov;12(11):e007386.
5. Rathore S. Impact of length and coating of intruducer sheath and compression haemostatic devices on clinical outcomes and vascular injury in relation to transradial coronary procedures. The University of Liverpool (United Kingdom); 2012
6. 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. JACC: Cardiovascular Interventions. 2012 Jan;5(1):36–43.
7. Dahm JB, Vogelgesang D, Hummel A, Staudt A, Völzke H, Felix SB. A randomized trial of 5 vs. 6 French transradial percutaneous coronary interventions. Cathet Cardio Intervent. 2002 Oct;57(2):172–6.
8. Bertrand OF, Rao SV, Pancholy S, Jolly SS, Rodés-Cabau J, Larose É, et al. Transradial Approach for Coronary Angiography and Interventions. JACC: Cardiovascular Interventions. 2010 Oct;3(10):1022–31.
9. Saito S, Tanaka S, Hiroe Y, Miyashita Y, Takahashi S, Tanaka K, et al. Comparative study on transradial approach vs. transfemoral approach in primary stent implantation for patients with acute myocardial infarction: Results of the test for myocardial infarction by prospective unicenter randomization for access sites (TEMPURA) trial. Cathet Cardio Intervent. 2003 May;59(1):26–33.
10. Aurigemma C, Osama S, Burzotta F, Antonio LM, Giampaolo N, Porto I, et al. Usefulness of sheathless guiding catheters in patients with upper extremity vascular anomalies: Sheathless catheters in upper vascular anomalies. AsiaIntervention. 2020;6(1):43.
11. Noble S, Tessitore E, Gencer B, Righini M, Robert-Ebadi H, Roffi M, et al. A randomized study of sheathless vs standard guiding catheters for transradial percutaneous coronary interventions. Canadian Journal of Cardiology. 2016;32(12):1425–32.
12. Sgueglia GA, Di Giorgio A, Gaspardone A, Babunashvili A. Anatomic Basis and Physiological Rationale of Distal Radial Artery Access for Percutaneous Coronary and Endovascular Procedures. JACC: Cardiovascular Interventions. 2018 Oct;11(20):2113–9.
13. Adamo M, Hamon M, Valgimigli M. Trans-radial and Trans-femoral Intervention. In: Zhou Y, Kiemeneij F, Saito S, Liu W, editors. Transradial Approach for Percutaneous Interventions. Dordrecht: Springer Netherlands; 2017
14. 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. JACC: Cardiovascular Interventions. 2019 Nov;12(22):2235–46.
15. Gorgulu S, Norgaz T, Karaahmet T, Dagdelen S. Incidence and Predictors of Radial Artery Spasm at the Beginning of a Transradial Coronary Procedure. J Interven Cardiology. 2013 Apr;26(2):208–13.
16. Kiemeneij F, Vajifdar BU, Eccleshall SC, Laarman G, Slagboom T, Wieken RVD. Evaluation of a spasmolytic cocktail to prevent radial artery spasm during coronary procedures. Cathet Cardio Intervent. 2003 Mar;58(3):281–4.

17. Isawa T, Horie K, Taguri M, Ootomo T. Access-site complications of transradial percutaneous coronary intervention using sheathless guiding catheters for acute coronary syndrome: a prospective cohort study with radial ultrasound follow-up. Cardiovasc Interv and Ther. 2020 Oct;35(4):343–52.
18. Ong P, Athanasiadis A, Borgulya G, Vokshi I, Bastiaenen R, Kubik S, et al. Clinical Usefulness, Angiographic Characteristics, and Safety Evaluation of Intracoronary Acetylcholine Provocation Testing Among 921 Consecutive White Patients With Unobstructed Coronary Arteries. Circulation. 2014 Apr 29;129(17):1723–30.
19. Agostoni P, Biondi-Zoccai GGL, De Benedictis ML, Rigattieri S, Turri M, Anselmi M, et al. Radial versus femoral approach for percutaneous coronary diagnostic and interventional procedures. Journal of the American College of Cardiology. 2004 Jul;44(2):349–56.
20. Rao SV, Cohen MG, Kandzari DE, Bertrand OF, Gilchrist IC. The Transradial Approach to Percutaneous Coronary Intervention. Journal of the American College of Cardiology. 2010 May;55(20):2187–95.

The Journal of Teachers Association
Abbreviated Key Title: TAJ
Official Journal of Teachers Association Rajshahi Medical College