International Journal of Research in Medical Sciences
Rahman A et al. Int J Res Med Sci. 2024 May;12(5):1457-1461
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20241227

Original Research Article

Relation of radial artery occlusion after trans-radial percutaneous coronary intervention with the duration of hemostatic compression

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Received: 12 March 2024
Revised: 04 April 2024
Accepted: 08 April 2024

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ABSTRACT

Background: Trans-radial percutaneous coronary intervention (PCI) in cardiac procedures accesses coronary arteries through the wrist's radial artery. Post-PCI, hemostatic compression on the radial artery prevents bleeding and aids healing. Radial artery occlusion (RAO), a possible complication, involves blockage of the radial artery. This study aimed to assess the relationship between radial artery occlusion after trans-radial percutaneous coronary intervention with the duration of hemostatic compression.
Methods: This prospective observational study was conducted in the Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Dhaka, Bangladesh, spanning from September 2018 to August 2019. The study enrolled 140 patients who underwent percutaneous coronary intervention (PCI) through the trans-radial approach (TRA), randomly assigned to two groups: Group I (2-hour hemostatic compression after PCI) and Group II (6-hour hemostatic compression post-procedure). Data analysis was performed using SPSS version 23.0.
Results: In this study, early radial artery occlusion was observed in 4.3% of patients in group I and 12.8% in group II (P=0.04), while late radial artery occlusion occurred in 2.8% of patients in group I and 11.4% in group II, with a statistically significant difference (P=0.04). Multivariate logistic regression analysis identified a 6-hour hemostatic compression duration (P=0.01), post-procedural nitroglycerine use (P=0.03), and procedure time (P=0.03) as predictors of radial artery occlusion.
Conclusions: Reduced hemostatic compression duration is linked to a decreased occurrence of both early and late radial artery occlusion following trans-radial intervention.

Keywords: Duration of hemostatic compression, Percutaneous coronary intervention, Radial artery occlusion, Relation, Trans-radial

INTRODUCTION

The trans-femoral vascular access method is commonly employed for both diagnostic and therapeutic coronary interventions, but it is associated with higher rates of vascular complications and bleeding, especially in women and older patients, compared to radial access.[1] The trans-radial approach (TRA) is increasingly favored

and has become the preferred vascular access for cardiac interventions.[2] Radial artery occlusion (RAO) emerges as a significant issue following radial artery catheterization. While RAO is often asymptomatic, it can lead to serious complications such as hand ischemia.[3] The reported incidence of this complication shortly after the procedure varies widely in the literature, ranging from 2% to 18%.[4] RAO can be assessed through methods such as the radial pulse method, Barbeau's test (Plethysmography evidence), and color Doppler study. In a study conducted by Huang et al, the immediate occlusion rate was reported to be 4.7% using the radial pulse method (absent pulse) and 10.7% with the Doppler study.[5] Another study, assessing radial artery occlusion (RAO) through plethysmography evidence, revealed a 12% RAO rate with traditional hemostatic methods and 5% with patent hemostatic methods during the 24-hour follow-up.[6] The variability in RAO rates can be attributed to the persistence of radial pulse even after occlusion develops at the access site. The occluded radial artery distal stump has been found to maintain up to 70% of mean arterial pressure due to macro collateral circulation from the palmar arches, leading to a palpable pulse.[7] RAO is influenced by various demographic, clinical, and periprocedural factors. Factors such as low body weight, female gender, the use and dosage of anticoagulants, radial artery diameter, sheath size, the number of catheters, procedure duration, and the type and duration of access site compression after the procedure are associated with the occurrence of RAO.[8,9] In a recent study conducted in India by Garg et al., lower BMI, diabetes mellitus, preprocedural radial artery diameter ≤ 2.5 mm, low preprocedural peak systolic velocity, and a radial artery to sheath ratio <1 was identified as additional predictors of radial artery occlusion (RAO).[10] However, there is insufficient data on coronary procedures through the trans-radial approach (TRA) in the Bangladeshi population. A study presented by Patwary et al reported radial artery spasm in 7.5% of cases during coronary angiography (CAG).[11] Another thesis study at the National Institute of Cardiovascular Diseases (NICVD) by Kabir et al found radial artery spasm to be 17.1%[12]. Additionally, a thesis conducted by Matin et al at NICVD reported a 9.6% incidence of radial artery occlusion (RAO).[13] A study by Pancholy and Tejas M. Patel demonstrated that the incidence of early (24 hrs.) and chronic (30 days) RAO, as defined by Doppler ultrasound, was significantly lower in patients who received hemostatic compression for 2 hours after completing the procedure compared to those with 6 hours of hemostatic compression after completion of the procedure.[14] Both demographic and procedural variables were comparable between the two groups. Early (24 hrs.) radial artery occlusion was observed in 5.5% of patients in the 2-hour compression group and 12% of patients in the 6-hour group, with a statistically significant difference (P=0.025). Chronic (30 days) radial artery occlusion occurred in 3.5% of patients in the 2-hour compression group and 8.5% of patients in the 6-hour group, with a statistically significant difference (P=0.035). Occlusive compression emerged as the sole independent predictor of radial artery occlusion, with an Odds ratio of 13.1 (P=0.001). The study concluded that 2-hour compression was superior to the 6-hour approach.[14] The objective of this study was to assess the relationship of radial artery occlusion after trans-radial percutaneous coronary intervention with the duration of hemostatic compression.

METHODS

A prospective observational study was conducted between September 2018 and August 2019, at the Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD) in Dhaka, Bangladesh. A total of 140 patients who underwent percutaneous coronary intervention (PCI) through the trans-radial approach (TRA) were randomly assigned and divided into two groups, with each group comprising 70 cases. Group I received 2-hour hemostatic compression following trans-radial PCI, while Group II underwent 6-hour hemostatic compression post-procedure. Radial artery occlusion (RAO) was defined as the absence of antegrade flow, monophasic flow, or inverted flow in the Duplex study. Color duplex studies were conducted early (24 hours) and late (30 days) after the procedure in both groups to assess radial arterial blood flow. The study obtained approval from the ethical committee of the specified hospital, and comprehensive written consent was acquired from all participants before the initiation of data collection. All patients underwent routine pre-procedural and post-procedural 12-lead ECG at a paper speed of 25 mm/s and 10 mm/mV standardization. Baseline investigations included 12-lead ECG, RBS (Random Blood Sugar), serum creatinine, screening blood tests for Coronary Angiography (CAG) & Percutaneous Coronary Intervention (PCI), and echocardiography, which were conducted and documented. Duplex assessment of the radial artery was performed both early (after 24 hours) and late (after 30 days). This involved recording the demonstration of flow, flow direction, flow pattern (laminar, turbulent), flow profile (monophasic, biphasic, tri-phasic, inverted), and flow velocity. All demographic and clinical information of the participants were meticulously documented. Data were analyzed using SPSS version 23.0, and a P-value < 0.05 was considered as the threshold for statistical significance.

RESULTS

The mean age of the study population was 53.3±.6.6 and 53.5±8.7 in groups I and II respectively; P=0.85. In group I, 87.1% were male and 12.9% were female in Figure 1. In group II, 90% were male and 10% were female. Statistically, no significant association was seen in terms of sex among the study groups (P=0.59); the male-female ratio was 8:1. Patients with a history of smoking, diagnosed diabetes mellitus and hypertension, and family history of CAD were almost similar with no significant

association (P>0.05). The findings also indicated that the mean BMI was almost identical in group I and group II (26.4±1.3 vs. 26.7±1.5 kg/m^2) statistically insignificant difference (P=0.16). Unstable angina (UA) was higher in group II than in group I (24.3% vs. 17.1%, P=0.30) patients but did not reach the level of significance in Figure 2.

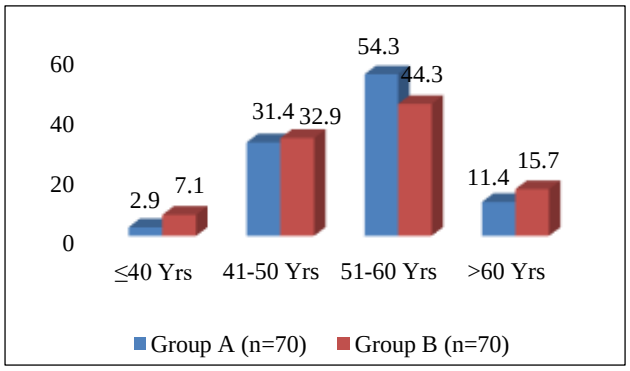

Figure 1: Column chart showed age wise patients distribution (n=140).

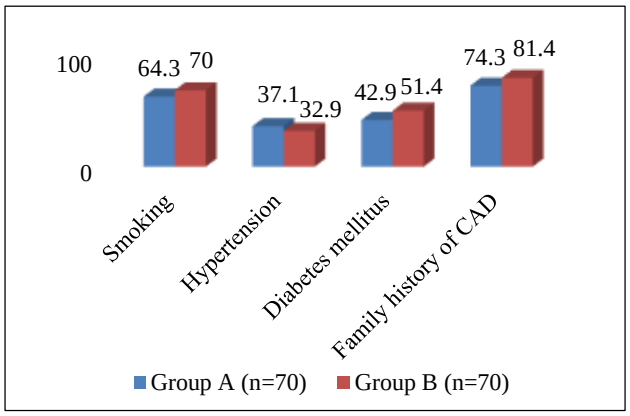

Figure 2: Column chart showed CVD risk factors among patients (N=140).

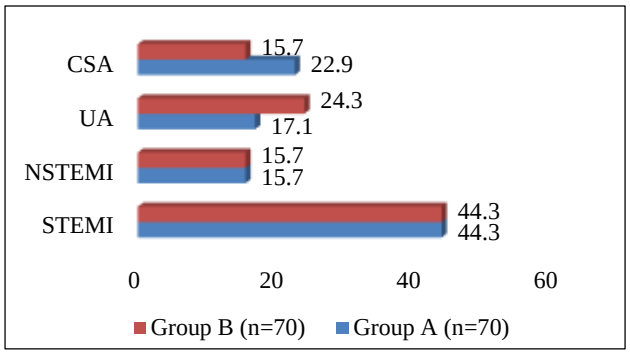

Figure 3: Bar chart showed diagnostic findings among patients (N=140).

On the contrary, coronary artery spasm (CSA) was higher in group I than in group II (22.9% vs. 15.7%, P=0.28) but did not reach the level of significance. There was no statistically significant association between the study groups by procedural and post-procedural characteristics (p>0.05) except palpation findings in Figure 3.

Table 1: Procedural and post procedural characteristics (N=140).

Variables	Group A (n=70)		Group B (n=70)		P-value
	n	%	n	%	
Sheath size used					
6French	64	91.4	65	92.9	0.75
5French	6	8.6	5	7.1	0.75
Types of sheaths used					
New	26	37.1	29	41.4	0.61
Sterilized	44	62.9	41	58.6	0.61
Nitroglycerin	38	54.3	32	45.7	0.31
Number of vessels stented					
1	60	85.7	55	78.6	0.27
2	10	14.3	15	21.4	0.27
Procedure time (min)					
Mean ±SD	53.3±8.2		55.1±9.1		0.23
Palpation findings					
AP at 24 hrs.	2	2.9	8	11.4	0.04
AP at 30 days	1	1.4	6	8.6	0.04
Spasm	9	12.8	11	15.7	0.62
Hematoma	2	2.9	3	4.3	0.64

Table 2: Multivariate logistic regression analysis of RAO with confounding factors (N=140).

Variables of interest	Odds Ratio (OR)	P-value
Age in years (>55)	1.034	1.118
Male gender	0.52	0.6
Smoking	2.188	0.34
Hypertension	1.573	0.5
Diabetes mellitus	1.076	0.91
Increased BMI kg/m^2	1.479	0.09
Sterilized sheath use	1.497	0.56
Nitroglycerin use	1.624	0.03
Procedure time	1.186	0.03
HC time 6 hours	7.149	0.01

Table 3: Duplex assessment of RAO (N=140).

Assessment	Group A (n=70)		Group B (n=70)		P-value
	n	%	n	%	
RAO at 24 hrs.	3	4.3	9	12.8	0.04
RAO at 30 days	2	2.8	8	11.4	0.04

Absent pulse at early (24 hours) was observed higher in group II than in group I (11.4% vs. 2.9%, P=0.04) with significant association. On multivariate logistic regression analysis to find independent predictors of RAO in Table 3 duration of hemostasis compression time 6 hours was found to be a strong predictor of RAO (Odds ratio [OR]=7.149, 95% Confidence Interval [CI] =1.212-

8.868; P=0.01). Radial artery occlusion (RAO) earlier (24 hours) was observed higher in group II than in group I (12.8% vs. 4.3%, P=0.04) with significant association. The same characteristic was also observed in group II than in group I (11.4% vs. 2.8%, p=0.04) at late (30 days) with significant association.

DISCUSSION

In this current study, a total of 140 cases were included. Regarding sex distribution, no statistically significant difference was observed in terms of sex among the study groups (P=0.59), with male patients being predominant (81.6%). A study by Dharma et al explored gender-based analysis between women and men, revealing no significant reduction in the risk of Radial Artery Occlusion (RAO) in women patients (odds ratio, 0.69; 95% confidence interval [CI], 0.38 to 1.26; P=0.147).[15] There was no significant difference in age distribution between the two groups, with the mean age of Group-I and Group-II patients being 53.3±6.6 vs. 53.5±8.7 years, respectively, and a P-value of 0.85. A thesis conducted by Matin et al found the mean age of the total population to be 50.39±9.31 years, and similar results were reported by Karimul et al.[16] Patients with a history of smoking, diagnosed diabetes mellitus, hypertension, and a family history of coronary artery disease (CAD) were almost similar between the two groups, with no significant associations (P>0.05). The findings also revealed that the mean Body Mass Index (BMI) was nearly identical in group I and group II (26.4±1.3 vs. 26.7±1.5 kg/m2), with a statistically insignificant difference (P=0.16). Similar results were reported by Karimul et al.[16] Overall, in group I, 44.3% had ST-Elevation Myocardial Infarction (STEMI), 15.7% had Non-ST-Elevation Myocardial Infarction (NSTEMI), 17.1% had Unstable Angina (UA), and 22.9% had Chronic Stable Angina (CSA). In group II, UA was higher than in group I (24.3% vs. 17.1%, p=0.30), while CSA was higher in group I than in group II (22.9% vs. 15.7%, P=0.28). This disease profile pattern was consistent with the findings reported by Matin et al.[13] There was no statistically significant association between the study groups in terms of procedural and post-procedural characteristics (P>0.05), except for palpation findings. Absent pulse at early (24 hours) was observed more frequently in group II than in group I (11.4% vs. 2.9%, P=0.04), with a significant association. The same characteristic was also observed more frequently in group II than in group I (8.6% vs. 1.4%, P=0.04) at late (30 days), also with a significant association. Studies using absent radial pulse as the only criterion for Radial Artery Occlusion (RAO) have reported immediate RAO rates in 2%-18% of patients.[4] In certain studies, using Doppler, the incidence of Radial Artery Occlusion (RAO) appears to be higher than when only using the absent pulse as a criterion for RAO. For example, in a study by Huang et al., the rate of immediate occlusion was reported as 4.7% by the radial pulse method and 10.7% by the Doppler study[3]. Another study conducted in Brazil found that the incidence of early RAO (within 7 days) was 10.5%.[17] In the present study, the incidence of the primary outcome, RAO at early (24 hours) after trans-radial Percutaneous Coronary Intervention (PCI), as defined by duplex ultrasound, was significantly lower in patients with 2 hours of hemostatic compression group (4.3% vs. 12.8%, P=0.04). Similarly, RAO at late (30 days) was significantly lower in Group I than in Group II (2.8% vs. 11.4%, p=0.04). A study by Pancholy et al also reported that early radial artery occlusion occurred in 5.5% of patients who received hemostatic compression for 2 hours after completing the trans-radial procedure, compared to 12% of patients who received hemostatic compression for 6 hours after the procedure; this difference was statistically significant (P= 0.025).[14] Chronic radial artery occlusion occurred in 3.5% of patients in the 2-hour hemostatic compression group and 8.5% of patients in the 6-hour compression group (P=.035).[14] The study also demonstrated that post-procedural nitroglycerin use reduced the incidence of Radial Artery Occlusion (RAO) (OR= 1.624; 95% Confidence Interval [CI] =1.110-11.304; P=0.03). Longer procedure time [OR=1.186, CI=1.097-1.289; P=0.03] was found to be significantly associated with the development of RAO. A study by Rashid et al (2016) found hemostatic compression time to be a significant predictor of RAO (P = 0.025).[18] The study conducted by Matin et al reported an incidence of RAO as 9.6% by Duplex ultrasound.[13] Similarly, a study by Karimul et al identified hemostatic compression time of more than 2 hours, post-procedural nitroglycerin use, and prolonged procedure time as predictors of RAO.[16]

This study, conducted at a single center, had a limited sample size and was carried out over a relatively short duration. As a result, the findings may not precisely reflect the overall scenario across the entire country.

CONCLUSION

The evidence of this study strongly supports the correlation between reduced hemostatic compression duration and a notable decline in the incidence of both early and late radial artery occlusion post-trans-radial intervention. This finding underscores the significance of optimizing compression protocols, emphasizing a potential avenue to enhance patient outcomes and minimize complications. Implementing shorter compression durations not only aligns with the principles of patient-centered care but also holds promise for improving procedural efficiency. As medical practices continue to evolve, these insights contribute valuable information for refining protocols and fostering advancements in interventional cardiology, ultimately enhancing the overall quality of patient care.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rahman A, Khan AKSZM, Shahriar MS, Islam DMK, Majumder MR, Masum MH, et al. Relation of radial artery occlusion after trans-radial percutaneous coronary intervention with the duration of hemostatic compression. Int J Res Med Sci 2024;12:1457-61.