ORIGINAL ARTICLE

LOSS OF RADIAL ARTERY PULSE AFTER CORONARY CATHETERIZATION THROUGH TRANS-RADIAL ROUTE IN PATIENTS ACUTE CORONARY SYNDROME

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Objectives: The objective of this study was to determine the frequency of loss of radial artery pulse after one month of the coronary catheterization through trans-radial route in patients diagnosed with acute coronary syndrome (ACS).

Methodology: A sample of consecutive patients diagnosed with ACS who undergo coronary catheterization through trans-radial route were evaluated for the loss of radial pulse through color Doppler ultrasound and clinical examination (palpatory) after one month of the intervention.

Results: A total of 115 patients were included, 107 (93%) of which were male patients, and mean age was 57.1 ± 9.9 years. Among these, 99 (86.1%) were diagnosed with ST elevation myocardial infarction (STEMI) and remaining 16 (13.9%) had non-ST elevation ACS. Only left heart catheterization was performed in 9 (7.8%) and 106 (92.2%) underdone percutaneous coronary intervention (PCI). The most commonly observed co-morbid condition was hypertension (47%) followed by diabetes (38.3%). A total of 72 (62.6%) were categorized as overweight/obese with body mass index of ≥ 25 kg/m2. The loss of radial artery pulse was noted in three (2.6%) patients at one month follow-up through both palpatory method and color Doppler ultrasound.

Conclusion: The loss of radial artery pulse was noted in a significant proportion of patients after one month of coronary catheterization in patients with ACS. Both palpatory assessment method and color Doppler ultrasound showed full concordance in the identification of patients with radial artery occlusion.

Keywords: ACS, coronary catheterization, trans-radial route, loss of radial pulse

Citation: Bhatti UH, Hussain M, Khan NU, Qadir F, Farman MT, Bhatti KI. Loss of Radial Artery Pulse after Coronary Catheterization Through Trans-radial Route in Patients Acute Coronary Syndrome. Pak Heart J. 2023;56(01):82-86. DOI: https://doi.org/10.47144/phj.v56i1.2483

INTRODUCTION

In the current era of interventional cardiology, the trans-radial vascular access is given preference over the conventional trans-femoral access for the either of the diagnostic or interventional procedures.[1] The clinical practice guidelines by both of the major societies, the American Heart Association and the European Society of Cardiology, recommend trans-radial vascular access as a Class IA indication for the diagnostic and interventional procedures in patients with acute coronary syndrome (ACS).[2,3] Compared to the traditional trans-femoral access, superiority of the trans-radial access has come to surface in various observational studies and well as clinical trials and it has been found to be associated with a decreased risk of vascular access complication and bleeding as well as mortality.[4-6] The loss of radial artery pulse or radial artery occlusion remained major drawback to the trans-radial approach.[7]

The incidence of radial artery occlusion is reported in a varying ranges depending on the method of assessment was well as timing of assessment of radial artery patency after coronary intervention. It has been reported to be 7.7% in early hours (≤ 24 hours) after the intervention and 5.5% on the subsequent follow-up after more than a week time.[8] In most cases, the radial artery occlusion are benign and asymptomatic in nature, however, it will not only precludes the radial access for future interventions but it also restrict the use of radial arterial conduit for coronary artery bypass grafting (CABG) (when needed) and creation of arteriovenous fistula (when needed) for hemodialysis.[1,9] In clinical practice routine assessment of radial artery patency is very sub-optimal and mostly done by simple palpation-based technique which

generally leads to underestimation.[10,11] The color Doppler ultrasound is the preferred method, in addition to accurate detection of radial artery occlusion, it can also provide important information regarding anatomical aspects of the radial artery such as radial flow, presence of dissection, or atrial thrombus.[1]

Multiple clinical patient- and procedure-related factors are to be considered in order to minimize the risk of radial artery occlusion. Such factors included, body weight of the patient, gender of the patient, dose of anticoagulant, size to the sheath in relation to the diameter of the radial artery, procedure duration, number of catheters, and duration and method of compression after procedure to achieve hemostasis.[7] In accordance with the newer clinical practice guidelines, in recent years we have observed a dramatic shift from conventional trans-femoral to trans-radial approach for the coronary interventions in our parts of the world too.[5] However, a very limited local data are available regarding the assessment of radial artery patency after coronary interventions for acute coronary syndrome. Therefore, aim of this study was to determine the frequency of loss of radial pulse after one month of the coronary catheterization through trans-radial route in patients diagnosed with ACS.

METHODOLOGY

A sample of consecutive patients diagnosed with acute coronary syndrome (ACS) who undergo coronary catheterization through trans-radial route were evaluated for the loss of radial pulse through color Doppler ultrasound after one month of the intervention. This study was conducted at a tertiary care cardiac hospital namely the National Institute of Cardiovascular Diseases (NICVD), Karachi, Pakistan between 28th September 2021 and 27th March 2022. Study was conducted as part of fellowship program in adult cardiology and it was approved by the research and evaluation unit of the College of Physicians and Surgeons Pakistan (CPSP). Consent for participation and follow-up color Doppler ultrasound was taken from all the selected patients.

The specific inclusion criteria were; adult patients of either gender, between 30 and 70 years of age, diagnosed with ACS, and undergone cardiac catheterization through trans-radial approach. The specific exclusion criteria were; patients with the history of coronary artery bypass grafting (CABG), chronic renal failure (serum creatinine > 1.5 mg/dl), previous history of catheterization through trans-radial route, pre-existing chronic liver or hepatic failure, intracoronary ultrasound, indication for rotational atherectomy, intra-aortic balloon pump (IABP), systemic vasculitis, and history of trauma to hand/arm.

Data for the study were collected on a predefined structured proforma consisted of demographic data like age, gender, body mass index (BMI), and comorbid conditions like diabetes mellitus (documented history of diabetes and on anti-diabetic medications for more than six months), hypertension (documented history of hypertension and on anti-hypertensive drugs for more than six months), and active smoker (currently smoking 10 or more cigarettes a day for the last one or more years). The ACS was further categorized as STEMI (ST-segment elevation myocardial infarction) and non ST elevation acute coronary syndrome (NSTEACS). Based on the clinical indications patients underwent either left heart catheterization (LHC) or percutaneous coronary intervention (PCI). All the procedures were performed by the team of consultant cardiologists using 5F sheath size. After procedure radial puncture was managed by the pressure technique with the help of TR band. Duration of procedure (minutes) as well as duration of TR band (hours) were also recorded. All the patients undergone color Doppler ultrasound after one month of the procedure. The absence of radial pulse on clinical examination (palpatory) and absence of flow in the radial artery on color Doppler ultrasound (Doppler) was taken as loss of radial pulse.

A sample size of 115 patients was calculated based on expected prevalence guess of 39.7%[12], 95% confidence level, and 9% margin of error. Data were summarized by computing mean ± standard deviation (SD) or median [interquartile range (IQR)] for continuous and frequency (%) for categorical variables. The study the effect of confounding variables on the rate of loss of radial pulse was evaluated by conducting independent sample t-test/Mann-Whitney U-test or Chi-square/Fisher's Exact test, appropriately at 5% level of significance. All the statistical analysis were performed with the help of IBM SPSS version 21.

RESULTS

A total of 115 patients were included, 107 (93%) of which were male patients, and mean age was 57.1 ± 9.9 years. Among these, 99 (86.1%) were diagnosed with STEMI and remaining 16 (13.9%) had NSTEACS. Only LHC was performed in 9 (7.8%) and 106 (92.2%) underdone PCI. The most commonly observed co-morbid condition was hypertension (47%) followed by diabetes (38.3%). A total of 72 (62.6%) were categorized as overweight/obese with

BMI ≥ 25 kg/m2. The loss of radial artery pulse was noted in three (2.6%) patients at one month follow-up through both palpatory method and color Doppler ultrasound (Table 1).

Table 1: Distribution of demographic and clinical characteristics and rate of loss of radial pulse

	Total
Total (N)	**115**
Gender	
Male	107 (93%)
Female	8 (7%)
Age (years)	57.1 ± 9.9
≤ 50 years	32 (27.8%)
>50 years	83 (72.2%)
Body mass index (kg/m^2)	26.6 ± 4.1
< 25 kg/m^2	43 (37.4%)
≥ 25 kg/m^2	72 (62.6%)
Diabetes mellitus	44 (38.3%)
Hypertension	54 (47%)
Active smoker	36 (31.3%)
Type of acute myocardial infarction	
STEMI	99 (86.1%)
NSTEACS	16 (13.9%)
Procedure	
Left heart catheterization	9 (7.8%)
Percutaneous coronary intervention	106 (92.2%)
Duration of procedure (minutes)	50 [40-60]
Duration of TR band (hours)	4 [4-5]
Loss of radial pulse	
Palpatory	3 (2.6%)
Doppler	3 (2.6%)

STEMI: ST elevation myocardial infarction, NSTEACS: non ST elevation acute coronary syndrome

The rate of loss of radial pulse stratified for the various demographic and clinical characteristics are presented in Table 2.

Table 2: The rate of loss of radial pulse stratified for the various demographic and clinical characteristics

	Total (N)	Loss of radial pulse (rate)		P-value
		Yes	No	
Gender				
Male	107	3 (2.8%)	104 (97.2%)	>0.999
Female	8	0 (0%)	8 (100%)	
Age (years)	-	50.3 ± 5.5	57.3 ± 9.9	0.232
≤ 50 years	32	2 (6.3%)	30 (93.8%)	0.187
>50 years	83	1 (1.2%)	82 (98.8%)	
Body mass index (kg/m^2)	-	25.5 ± 3.4	26.7 ± 4.1	0.645
< 25 kg/m^2	43	1 (2.3%)	42 (97.7%)	>0.999
≥ 25 kg/m^2	72	2 (2.8%)	70 (97.2%)	
Diabetes mellitus	44	1 (2.3%)	43 (97.7%)	>0.999
Hypertension	54	0 (0%)	54 (100%)	0.246
Active smoker	36	1 (2.8%)	35 (97.2%)	>0.999
Type of acute myocardial infarction				
STEMI	99	1 (1%)	98 (99%)	0.050
NSTEACS	16	2 (12.5%)	14 (87.5%)	
Procedure				
Left heart catheterization	9	1 (11.1%)	8 (88.9%)	0.219
Percutaneous coronary intervention	106	2 (1.9%)	104 (98.1%)	
Duration of procedure (minutes)	-	60 [20-70]	50 [40-60]	>0.999
Duration of TR band (hours)	-	4 [4-8]	4 [4-5]	0.684

STEMI: ST elevation myocardial infarction, NSTEACS: non ST elevation acute coronary syndrome

DISCUSSION

The loss of radial artery pulse generally known as radial artery occlusion is a potential complication after cardiac catheterization through trans-radial approach which required proper assessment and follow-up. Hence, we conducted this study to evaluate the rate of loss of radial pulse at one month follow-up color Doppler ultrasound in patients who undergone coronary catheterization via trans-radial route. In this study only three patients (2.6%) were identified with loss of radial artery pulse on palpatory assessment method as well as on color Doppler ultrasound assessment. Although, due to low event rate we could not found any statistically significant association between the radial artery occlusion and various patient- and procedure-related factors.

Contrary to our findings, a significantly higher proportion of radial artery occlusion has been reported in a study conducted by Butt UM et al.[12] in our local population. They included 131 patients who underwent percutaneous cardiac catheterization via the trans-radial approach and 39.7% of them were found to have radial artery occlusion on color Doppler ultrasound after 24 hours of the procedure. They also found significant association between the rates of radial artery occlusion with type of intervention, duration of procedure, gender, and age of the patient. As it has been proven that rate of radial artery occlusion after trans-radial cardiac catheterization is negatively associated with timing of assessment.[8] Hence, the possible explanation for differences in the rates of radial artery occlusion in our study and the study conducted by Butt UM et al.[12] is due to the differences in the time of assessment. Similarly, another study by Sadaka MA et al.[13] evaluated radial artery patency through Doppler ultrasonography after one day and 6 months of the after percutaneous

coronary interventions in 164 patients. Radial artery occlusion was reported in 32.9% and 29.9% of the patients after one day and 6 months, respectively. Study further reported radial artery diameter, manual compression, age, and female gender were reported to be independent predictor on multivariable analysis.[13]

Among various other factors, it has been reported that shorter duration of post procedure compression time and higher dose of anticoagulation can effectively lower the risk of radial artery occlusion.[14] A study conducted by Khalid W et al.[15] compared intravenous vs. intra-arterial heparin use for the prevention of radial artery occlusion after coronary angiography. Both the intra-arterial and intravenous routes of heparin administration showed equal efficacy with the radial occlusion rates of 5.6% vs. 6.9% after 24 hours of diagnostic coronary angiography, respectively. Considering the importance of compression duration, Takamatsu S et al.[16] conducted a study to compare the conventional protocol (the removal of fixed amount of air after two and three hours of the procedure) to the new protocol (the removal of as much of as air after every 30 minutes). With a mean time to achieve the complete hemostasis as 66 ± 32 vs. 190 ± 16 minutes with new vs. old protocol, respectively, a significantly lower rate of radial artery occlusion was noted with the new protocol, i.e. 0.9% vs. 9.8% with new and conventional protocol, respectively.[16]

Even though this study was conducted at the largest cardiac care hospital of the country, but certain limitations bounds the generalizability of study findings which included small sample size and single center coverage.

CONCLUSION

The loss of radial artery pulse was noted in a significant proportion of patients after one month of coronary catheterization in patients with ACS. Both palpatory assessment method and color Doppler ultrasound showed full concordance in the identification of patients with radial artery occlusion. Hence, due to possible operator-related variations in the palpatory assessment, post-procedure follow-up assessment should also include color Doppler ultrasound for the assessment of radial artery patency.

AUTHORS' CONTRIBUTION

UHB and MH: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. NUK, FQ, MTF, and KIB: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

Conflict of interest: Authors declared no conflict of interest.

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