RATE OF RADIAL ARTERY PATENCY ON THE BASIS OF CLINICAL AND RADIOLOGICAL EXAMINATION AT ONE MONTH FOLLOW-UP POST PERCUTANEOUS CORONARY INTERVENTION

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ABSTRACT:

BACKGROUND: *Trans-radial angioplasty has various advantages over trans-femoral approach and it is a feasible route for percutaneous coronary intervention and may be related to occlusion of radial because of its significant complication, radial artery occlusion.*

AIMS & OBJECTIVE: *The objective of the study is to assess the radial artery patency after transradial coronary intervention.*

MATERIAL & METHODS: *The observational prospective study was carried out at cardiology department at Punjab Institute of Cardiology Lahore from October 2020 to March 2021. by non-probability consecutive sampling. All the patients who underwent transradial coronary intervention were enrolled for the study and were assessed for radial artery occlusion (RAO) after one month follow-up. Radial blood flow, demographic characteristics and risk factors was recorded during the study. Data was analyzed and expressed as mean ± S.D. and percentages.*

RESULTS: *The study included 155 patients, out of which 15 developed radial artery occlusion. Significant difference was observed for gender (p=0.04) and age (p = 0.04).*

CONCLUSION: *Trans radial approach (TRA) is a safe procedure and have huge range of benefits over transfemoral approach. Comparatively higher number of radial artery patency patients in our study further supports the well-established safety of transradial approach.*

KEY WORDS: *Radial artery patency, clinical and radiological examination, percutaneous coronary intervention.*

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BACKGROUND:

In 1989, Campeau et al. introduced transradical coronary angiography [1] which led to the first documentation of coronary angioplasty and stenting through transradical approach (TRA) by Kiemeneij et al. in 1993.[2] Although, the implementation of the transfemoral approach (TFA) is common for coronary angiography and treatment, there is an increase in percutaneous interventions via radial artery.[1-4] Due to the concerns of vascular access complications in cardiac catheterization, the TRA is known around the world rather than TFA.[5-7] In comparison with TFA, the TRA has also depicted the reduction of major bleeding.[8] Radial method favours for comfort, shorter stay in hospital, sooner patient mobilization, and decreased cost.[9-10]

Nevertheless, transradial catheterization may lead to the complication of Radial artery occlusion (RAO) which results in the permanent occlusion in the radial artery. It has an estimated occurrence in 1-18% of the patients[11-18] and has been termed as "Achilles' heel" of the transradial approach.[19] RAO is often neglected because it is commonly clinically silent because of the blood supply in the palm from both the radial and the ulnar artery.[20] In account of that, the radial artery patency is not routinely assessed by over 50% of transradial operators before the patients discharge from the hospital[21] and symptomatic RAO occur only in 0.2% of the patients that require medical attention.[7] The RAO occurs shortly after the transradial catheterization, and spontaneous recanalization occurs in the artery between 1 and 3 months in 50% of the patients.[12-14]Despite that, the complication cannot be considered benign owing to the reports of hand ischemia from RAO.[22-24] Moreover, the occlusion of radial artery will cause it to become unusable for catheterization in the future or as arterial channel for bypass surgery. The ipsilateral ulnar artery also cannot be used because of RAO as cannulating and instrumenting the ulnar artery renders the risk of hand ischemia in the patient.

The rates of RAO are largely variable in previously published data. The huge variance might correspond to the evidence that after catheterization, the assessment of radial artery patency was carried out by pulse palpation and clinical forearm inspection instead of vascular ultrasound in the studies. Regardless of complete occlusion due to retrograde filling of the radial artery via collaterals, palpable pulse can be observed in some patients. According to a study, shortly after transradial catheterization, in only 2% of the patients, an absence of radial pulse was observed but 9% of the pateints radial flow was undetectable using color doppler.[25] Given that, the diagnosis of RAO should be validated by duplex ultrasonogram and should not be depended upon the absence or presence of a radial pulse. Besides, majority of these studies included the targeted population of TRA which was mixed, angioplasty along with diagnostic transradial coronary angiography.[26-29] Consequently, there is no adequate number of studies available that investigated RAO in patients undergoing transradial coronary angioplasty exclusively. The factors, particularly, gender, body weight, smoking, co-morbidity (in case of peripheral vascular disease or diabetes mellitus, radial artery diameter, number of catheters utilized, procedure repetition, duration of procedure and the dose of anticoagulant are responsible for the occurrence of RAO. The most significant factor among these is the radial artery size and a study reported that unfortunately in Pakistani population, approaching for cardiac catheterization, the mean diameter of the radial artery was observed to be 2.25 ± 0.4 mm which is found to be a bit smaller as compared to other populations.[30] In correspondence to that, higher probability of RAO and lower rates of radial artery patency following angioplasty can be assumed in Pakistani population. In consideration of the observation of radial artery diameter and limitation of data regarding radial artery patency after transradial coronary angioplasty in Pakistan, the objective of the study was to assess the radial artery patency after transradial coronary angioplasty, and the risk factors linked to radial artery occlusion.

MATERIAL AND METHODS:

The observational prospective study was carried out at cardiology department at Punjab Institute of Cardiology Lahore from October 2020 to March 2021. The selection of patients was accomplished using consecutive (non-probability) sampling method. All the patients who underwent percutaneous coronary intervention (PCI) through transradial approach were included in the study. The inclusion criteria were set as: age>18 years, positive Allen's test, and consent for participation in the study, that considered for returning a month following the procedure for the assessment radial artery blood flow. Patients with negative Allen's test, having history of coronary artery bypass graft (CABG) surgery and with history of peripheral arterial disease with ankle brachial pressure index<0.90 verified on Doppler Ultrasound examination were excluded. The ethics committee of the institution approved the study.

Assessment of radial artery blood flow and clinical follow-up:

The patients were clinically examined by radial pulse palpation. Radial artery occlusion (RAO) was considered as the loss of radial pulse on palpation, validated by loss of audible blood flow sound across the radial artery examined through portable hand-held doppler and the Doppler ultrasonography was used to perform radiological examination.

The patients after the transradial procedure, were followed up at the time of discharge (1-3 days) during which the evaluation of complain and sign of ischaemic hand pain was assessed and clinical examination was performed followed by Doppler ultrasonography for the assessment radial artery patency.

After one month, the evaluation was again carried out for the assessment of radial artery patency in the patients by the same clinical and radiological examination.

PROCEDURAL DATA:

For the enrollment, informed consent was taken from the patient. Routine history was taken and physical examination of the patients was performed, ECG and other baseline tests like electrolytes and complete blood picture were obtained. Allen's test was performed before transradial PCI. All the patients undergoing PCI received 100 IU/ kg(10,000 IU maximum) of heparin. For all patients, Hydrophilic Radial sheaths of 6F were used, and hemostasis was accomplished with TR compression band after the procedure was completed. The duration of the procedure was recorded. The body mass index (BMI), smoking, diabetes and hypertension were the clinical baseline characteristics of the patients recorded for the study. Medical records of the patients were concerned for the demographic (age and gender), clinical and procedural data and recorded in a particular database.

STATISTICAL ANALYSIS OF THE DATA:

SPSS, release 20.0 was used for the statistical analysis of the study variables. Continuous variables and categorical variables were shown as the mean and standard deviation and as absolute numbers and percentages, respectively. Variables, particularly age,gender, hypertension, diabetes mellitus, smoking status, and procedure duration were stratified to assess their impact on the outcomes with the help of chi-square test. The significant value was considered as $p > 0.05$.

RESULTS:

Baseline and clinical characteristics

There were 155 eligible patients enrolled in the study. Out of the total patients, 101 (65.2 %) were male and 54 (34.8 %) were female. The mean age of the patients was 58.22 ± 9.3 years, and the mean weight and BMI was observed to be 70.54 ± 9.23 kg and 26.1 ± 4.36, respectively. From the total no. of patients, 72 (46.4 %) were hypertensive, 87(65 %) were diabetic and 59 (38 %) were reported to have a habit of smoking.

In 44 (28.4 %), 79 (51 %)and 32(20.6%) patients, the length of the procedure was < 30 minutes, < 60 minutes and more than 60 minutes, respectively.

Clinical follow-up and radial artery blood flow assessment

One month after the intervention procedure, the radial artery flow was evaluated and found to be absent in 13 (8.4 %), impaired in 2(1.3%) and normal in 140 (90.3%) patients (Table 1).

Associated Risk Factors

The correlation of RAO with gender, age and associated risk factors is demonstrated in Table 2.

Table 1. Evaluation ofblood flow of the radial arterial by Doppler ultrasonography

Pre-procedure	n (%)
Normal flow	155 (100 %)
Reduced/ impaired flow	0 (0 %)
Absent flow	0 (0 %)
After One Month Follow-up	
Normal flow	140 (90.3%)
Reduced/ impaired flow	2(1.3%)
Absent flow	13 (8.4 %)

Table 2. Radial Artery Occlusion FrequencyafterTransradial Coronary Intervention with Respect to Gender, Age and Risk Factor and Their correlation with RAO

Variable	Radial Occlusion		Total	p-value
	Yes (n = 15)	No (n =)		
Gender				
Male	6 (5.9 %)	95 (94.1 %)	101	0.03
Female	9(16.6 %)	45 (83.3 %)	54	
Age				
Below 50 years	0 (0 %)	46 (100 %)	46	0.04
Above 50 years	15 (13.7 %)	94 (86.2 %)	109	
Hypertension				
Yes	12 (16.6 %)	60 (83.3 %)	72	0.69
No	3 (3.6 %)	80 (96.3 %)	83	
Diabetes mellitus				
Yes	9 (10.3 %)	78 (89.6 %)	87	0.56
No	6 (8.8 %)	62 (91.1 %)	68	
Smoking				
Yes	8 (13.5 %)	51 (86.4 %)	59	0.07
No	7 (7.3 %)	89 (92.7 %)	96	
Procedure length				
Less than 30 minutes	2 (4.5 %)	42 (95.4 %)	44	2.98
Less than 60 minutes	8 (10.1 %)	71 (89.9 %)	79	
More than 1 hour	4 (12.5 %)	28 (87.5 %)	32	

DISCUSSION:

The current study targeted to deduce radial artery patency after angioplasty through transradial approach in Pakistani population as there is a lack of local research and lesser implementation of transradial approach in spite of its widely established safety.

Asymptotic RAO is the commonly encountered complication of transradial catheterization, the rates of which variably range between 2% and 18% among the patients.[11-18] In our study, 9.6 % of patients developed a complete or partial radial artery occlusion. The observed frequency is slightly less in comparison with a study carried out by Zankl et al.[15] reporting the frequency of 10.5%. The determined frequency is also less as compared to another large-scale non-randomized prospective study by Tuncezet al[31] which reported the frequency of 9.4%. Our results are in accordance with the study conducted by Abdelaalet al[32] where the incidence rate was found to be 7% after 28 days and with a systemic review and meta-analysis by Rashid et al which reported 7.7% and 5.8% incidence rate in first 24 hours and 30 days, respectively. However, it was significantly higher than Chowdhury el al. (1.45%).[28]

Usually, the absence of radial pulse is clinically described as the occlusion of radial artery. However, this description can contribute to the underestimation of actual frequency of RAO as one such study reported the RAO incidence rate to be 44% determined by the absence of radial pulse whereas, the absence of radial artery blood flow actually turned out to be 10.5%.[13] In another study, the absence of radial artery blood flow was determined to be 4.91% although with fine palpable pulse.[33] For this reason, more objective method was suggested for the assessment of RAO considering radial flow determined by the implementation of ultrasound.[34]

Our study reported the statistically significant difference of RAO with respect to gender distribution. Among the total of 15 (9.6 %) patients with RAO, 9 were females and 6 were males (p = 0.03). These findings are in accordance with the reports of the study by Tuncez et al[31] which showed the occurrence of

RAO in patients among which 80% were females and also in a meta-analysis published by Rashid et al[35],in which the incidence of RAO in females was reported to be 66.7%. The most probable reason for that is the smaller diameter and greater tendency of contraction of radial artery in females than in males.

The mean age in the current study was 58.22 ± 9.3 years which is comparable to that of 58.1 years reported by Tuncez et al.[31] Apart from gender, age can also be helpful in the prediction of RAO as its incidence is found to be higher in elderly patients with above 60 years age. Patients above 50 years showed RAO in our study ($p = 0.04$).

Among 15 RAO patients, the duration of the procedure was <30 minutes, <60 minutes and more than an hour in 2, 8 and 4 patients, respectively. Additionally, the p value of 2.98 was analyzed for the effect of the length of procedure on RAO which is statistically insignificant and corresponds with the international study by Tuncez et al.[31]

In several randomized studies, the risk factors associated with RAO were no use of anticoagulant, radial artery's extended high-pressure compression and small ratio of radial to sheath size. In the current study, 5000 IU of heparin was used in patients undergoing coronary angiogram and 100 IU/kg (maximum of 10,000 IU) was used in PCI patients.[6] F hydrophilic radial sheath were used in all of the patients and at the end of the procedure, hemostasis was achieved using pressure adjusted TR band.

With regard to risk factors responsible for atherosclerosis, diabetes and hypertension were observed to be common risk factors followed by smoking habits among the enrolled patients. Although no significant difference was reported regarding any of the risk factors, still slightly higher frequency of RAO was observed in patients associated with any of the risk factors. These risk factors are evident to be the predictors of non-patency based on results of various studies.[14, 36-37] Farooque et al. also reports that diabetes and dyslipidemias are strongly associated with non-patency and the chances of non-patency are increased with the existence of multiple risk factors.[33]

CONCLUSION:

Trans radial approach (TRA) is a safe procedure and have huge range of benefits over trans-femoral approach. Its significant complication is RAO which can be discouraging for many operators. However, the adequate management throughout the procedure time, such as higher anticoagulant dose and shorter compression time after the procedure can serve as satisfactory alternatives to reduce the risk of RAO. Comparatively normal patency in higher number of patients in our study clarifies the well-established safety of transradial approach.

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