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RADIAL ARTERY OCCLUSION FOLLOWING TRANSRADIAL CORONARY INTERVENTION

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Contribution

FA conceived and designed the study. NK did data collection and manuscript writing. IKS did review and final approval of manuscript. All authors contributed equally to the submitted manuescript.

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ABSTRACT

Objective: To determine the frequency of radial artery occlusion following transradial coronary intervention in acute myocardial infarction patients.

Methodology: This cross-sectional study was conducted at cardiology department Liaqat National Hospital Karachi from 22nd October 2016 to 21st April 2017. Patients with myocardial infarction going for coronary intervention performed through radial artery were recruited in this study. Radial artery was palpated and coronary artery intervention was performed through radial artery after procedure patient was shifted to recovery, palpate radial artery after 6hrs and then Doppler ultrasonography was performed which shows no flow, impaired flow or normal laminar flow.

Results: A total of 180 patients with myocardial infarction going for coronary intervention performed through radial artery were recruited in this study. About 79% of the patients were above 4 years of age. There were 55.56% male. Diabetes and hypertension were the commonest factor followed by smoking. Frequency of radial artery occlusion following transradial coronary intervention in acute myocardial infarction was observed in 18.89% cases. With respect to age stratification, rate of radial artery occlusion was observed in the range of 14.3% to 23.7% in different age groups ($p=0.734$). Rate of radial artery occlusion was approximate similar in male and female ($p=0.96$) while rate of occlusion was significantly higher in obese (BMI >30 kg/m2) as compared to the overweight and normal cases ($p=0.011$).

Conclusion: The use of transradial PCI is not only beneficial to reduce bleeding but also for ischemic complications and mortality in high-risk patients undergoing coronary interventions.

Key Words: Transradial coronary angiography, Radial artery occlusion, Acute myocardial infarction.

INTRODUCTION

Introduction of transradial coronary angiography is followed as it was worked on firstly by Campeau et al. in 1989.[1] Their names come first because of documenting coronary angioplasty and stenting by the use of transradial approach (TRA) in 1993.[2] In the United Kingdom, Transradial access (TRA) has become the default access site; it is also there in Europe, and Asia and is quickly developing in the United States as well.[3-8] Whereas for the conduction of coronary angiography and interventions, transfemoral approach (TFA) is known as the most common method. Nowadays, a great number of interventional cardiologists is performing percutaneous interventions through the radial artery.[9-11]

In high risk group of patients, TRA has less mortality and adverse cardiac events as compared to transfemoral access; it reduces vascular complications and major bleeding, furthermore it reduces discomfort of patients and allows earlier mobilization and on other hand, it is also facilitates the less cost of procedure.[12,13] TRA is challenging and with complications though. It is technically difficult with longer learning curve with radial artery occlusion (RAO) and with radial artery spasm in female and elderly patients particularly.[14,15]

Radial Artery Occlusion (RAO) is inactive complication of TRA which hardly leads to serious hand ischemia requiring invention due to hand`s double vascular supply from the palmar arch. RAO is usually disregarded and before discharge, >50% operators do not even assess radial artery patency.[7] Different research studies have indicated significant benefits with TRA, because of having somewhat lesser potential for access site bleeding and higher comfort or satisfaction of patients during maintaining high procedural success rates on the whole.[16,17]

A number of research studies have evaluated the prevalence and risk factors for RAO, with various studies analyzing interventions to minimize its likelihood. This study was conducted with the objectiveto investigate its occurrence and factors that have an impact of RAO in the TRA setting.

METHODOLOGY

This cross-sectional study was conducted from October 22nd, 2016 to April 21, 2017. Inclusion criteria for the study population was either gender with the age of 30 to 70 years, who were diagnosed cases of myocardial infarction going for coronary intervention performed through radial artery, in the outpatient clinics and inpatients attending department of Cardiologyat Liaquat National Hospital Karachi.

After approval from ethical committee of Liaquat national hospital, patients presenting in cardiac catheterization laboratory for coronary intervention and fulfilling the inclusion criteria were included. Patients were counseled and given detailed information about the protocol and written informed consent was taken from all patients by principal investigator. Radial artery was palpated and coronary artery intervention was performed through radial artery by interventional cardiologist, after procedure patient was shifted to recovery, palpate radial artery after 6hrs and then Doppler ultrasonography was performed which shows no flow, impaired flow or normal laminar flow.

Data was compiled and analyzed in statistical package of social science (SPSS) version 22.The Mean ± SD was calculated for quantitative variable i.e. age, hypertension, BMI. The frequency and percentages was calculated for qualitative variables i.e. gender, risk factors smoking, diabetes mellitus and hypertension. Stratification was done on gender, age, BMI, smoking status, diabetes mellitus, hypertension to see their effect on outcome using chi square test and $p \leq 0.05$ was considered as significant.

RESULTS

A total of 180 patients with myocardial infarction going for coronary intervention performed through radial artery were recruited in this study. Seventy nine percent of the patients were above 40 years of age. Age distribution of the cases is presented in table1. The demographic of the patients is also presented in table 1. There were 55.56% male and 44.44% female (table 2). Regarding atherosclerotic risk factor, diabetic and hypertension was the commonest factor followed by smoker.

Frequency of radial artery occlusion following transradial coronary intervention in acute myocardial infarction was observed in 18.89% (34/180) cases as presented in table 6. With respect to age stratification, rate of radial artery occlusion was observed in the range of 14.3% to 23.7% in different age groups but significant difference was not observed ($p=0.734$) as shown in table 2. Rate of radial artery occlusion was approximate similar in male and female ($p=0.96$) while rate of occlusion was significantly high in obese (BMI >30 kg/m^2) as compare the overweight and normal cases ($p=0.011$) as presented in table 3. Frequency of radial artery occlusion following transradial coronary intervention with respect to atherosclerotic risk factor was observed insignificant as presented in table 4.

Table 1: Descriptive Statistics of Study Patients (n=180)

Variables	Mean	Std. Deviation	Lower Bound	Upper Bound	Median	IQR
Age (Years)	50.74	10.35	49.22	52.26	50.00	18
Height (cm)		10.90	163.96	167.17	170.00	20
Weight (kg)	70.36	8.93	69.04	71.67	69.00	17
BMI (kg/m^2)	25.91	4.34	25.28	26.55	24.81	5.86

Table 2: Frequency of Radial Artery Occlusion Following Transradial Coronary Intervention with Respect to Age Groups (n=180)

Age Groups (Years)	RADIAL ARTERY OCCLUSION		
	Yes	No	Total
	n=34 (%)	n=146 (%)	
31 to 40 Years	9(23.7%)	29(76.3%)	38
41 to 50 Years	10(18.9%)	43(81.1%)	53
51 to 60 Years	7(14.3%)	42(85.7%)	49
61 to 70 Years	8(20%)	32(80%)	40

Chi-Square=1.28; p=0.734

Table 3: Frequency OF Radial Artery Occlusion Following Transradial Coronary Intervention WITH RespecTO BMI

BMI (kg/m²)	RADIAL ARTERY OCCLUSION		
	Yes n=34	No n=146	Total
= 25 kg/m²	15(14.4%)	89(85.6%)	104
25.1 to 30 kg/m²	8(16.7%)	40(83.3%)	48
>30 kg/m²	11(39.3%)	17(60.7%)	28

Chi-Square=9.11; p=0.011

Table 4: Frequency of Radial Artery Occlusion Following Transradial Coronary Intervention with Respect to Risk Factor (n=180)

Atherosclrotic Risk Factor	RADIAL ARTERY OCCLUSION			
	Yes n=34 (%)	No n=146 (%)	Total	P Value
Smoker				0.06
Yes	18(25.7%)	52(74.3%)	70	
No	16(14.5%)	94(85.5%)	110	
Diabetic				0.58
Yes	19(17.6%)	89(82.4%)	108	
No	15(20.8%)	57(79.2%)	72	
Hypertension				0.73
Yes	16(20%)	64(80%)	80	
No	18(18%)	82(82%)	100	

Chi-Square test applied for each risk factor

DISCUSSION

In many countries, for cardiac catheterization, TRA has grown as the default access site, and approaches to preserve the radial artery`s patency for the use of future are becoming an integral part of the procedure of catheterization.

Clinically, radial pulse`s absence is usually termed as occluded artery; whereas, true incidence of RAO can be underestimated by the help of this. For example in one of the conducted research, the incidence of RAO was described by the absence of pulse came out to be 44 percent, however, radial artery`s absence came out to be 10.5%.[18] Therefore, more objective assessment method of RAO was suggested which was using radial flow as evaluated by ultrasound.[19]

Number of baseline characteristics of patients i.e. sex, age, body mass index (BMI), procedural variables (i.e. heparin use, artery-to-health ratio and duration of compression) have been indicated to be in association with RAO but there is much dispersion in relevant literature regarding this. Variation of RAO`s incidence has been reported according to the evaluation timing of post-procedure of radial artery patency. Acutely, the acute rates of RAO are higher and they decline with the passage of time. In the PROPHET study, RAO`s incidence came out to be 12% and it was almost halved with the duration of 28 days; thus came out to be 7%.[15]

Function and structure of radial artery is negatively affected by TRA, non-occlusive injury culmination.[14] Integrity of Vascular smooth and Endothelial muscle play leading role in conserving the function of an arterial wall. Damaged and dysfunctional endothelium has been indicated to be strongly attributed to the development of vascular disease and atherosclerosis.[20] Alterations in flow-mediated dilatation has been utilized as a substitute of endothelial dysfunction more

recently.[21] Flow-mediated dilatation (FMW) is in vivo bioassay of NO (nitric oxide)-mediated endothelial function in which vascular endothelium discharges NO as a vasodilatory response according to the variations in the vascular blood flow (VBF). It is indicated recently by Yan et al that average flow-mediated dilatation post 5-Fr was significantly minimized from 11.5 percent to 4.1% suddenly after the procedure and fell to 0.7 percent in the duration of 3 months.[22] It is suggested by this that endothelial damage can persist actually than it is perceived. Furthermore, structural damage to the radial artery is also resulted by TRA. The Structural changes were studied by Yonetsu et al from acute vascular trauma (AVT) and it was demonstrated that 67 percent of the radial arteries were having intimal tears and 36 percent were having medial dissections suddenly after transradial PCI.[23] The blend of these function and structural variations in arterial wall result in significant arterial remodeling, which may be possessed with the important clinical implications. E.g. It was demonstrated by Sakai et al that those patients to whom repeated transradial interventions occur in the same arm and said further that the successful radial access rate decreased with successive procedures.[24]

On a background of chronic occlusive changes, acute artery occlusion (AAO) is known to be a thrombotic phenomenon. Endothelial damage and exposing the thrombogenic connective tissueare caused during the insertion and instrumentation of Sheath during TRA. Furthermore, Nidus is provided by blood stasis during the achievement of hemostasis for thrombus formation. Thus, minimizing the endothelial damage by reducing the time of compression and the use of sheath size small introducer along with patent hemostasis may cause the reduction in occlusion rates. Saito et al investigated the association between sheath size outer diameter and arterial blood flow and it was indicated that blood flow reduction was significantly less when the inner diameter/sheath and outer diameter of radial artery was >1.0 (artery/sheath diameter ratio >1).[25]

There have been numerous developments in the designs of catheter and sheath since the its beginning; so that procedure can be facilitated and the insult to the artery can be minimized. Randomized trial of 790 sheaths having length of 23 cm versus 13 cm hydrophilic-coated or uncoated introducer sheaths; it was demonstrated by the researcher that neither length nor coating had an impact on RAO.[25] Whereas, it was suggested that injury to radial artery can be reduced which would result in lesser occlusion rates which is possible by the use of small diameter guide catheter.[26] By the help of this the design of catheter was innovated so that the outer diameter could be minimized which includes the sheathless guide catheters development. Typically a 6-Fr sheathless guide catheter has an outer diameter that is smaller than that of a 5-Fr introducer sheath. We performed a pooled analysis to study the effect of various sizes (3, 4, 5, 6, 7, and 8 Fr) on incidence of RAO.

In women, radial artery occlusion is frequently observed, which is found to be in relationship with radial artery of smaller diameter and its greater tendency to contract whereas, in this study radial artery occlusionrate was approximated same in male and as well as female (p=0.96).[27]

Regarding atherosclerotic risk factor, diabetic and hypertension was the commonest factor followed by smoker were found in our study. It is evident from different studies that the presence of diabetes, peripheral arterial disease and smoking are predictors of this complication.[28-30]

Frequency of radial artery occlusion(RAT) following transradial coronary intervention (TCI) in acute myocardial infarction (AMI) was observed in 18.89 percent (34/180) cases in the present study. In prospective observational study which was single-centered 488 consecutive patients were assessed by the help of ultrasound and after one day, transradial cardiac catheterization (TCC) for symptoms of RA occlusion were assessed.[31] Patients with signs who were identified sonographically for artery occlusion were treated with low-molecular-weight heparin (LMWH) for the duration of four weeksanticoagulation therapy, was not received by asymptomatic patients. Patency rate of radial artery was the primary endpoint at the follow-up duration of four week. Out of 488 patients, radial artery occlusion was found in 51 patients, after one day from the cardiac catheterization. Number of patients who were with symptoms on access site were 30 (58.8%); whereas, those patients who were not with any symptoms were counted to be 21 (41.2%). After the duration of four weeks, 26 (87.7%) of patients, who were with symptoms indicated little or complete canalization of radial artery after having the treatment with LMWH in comparison with 4 (19.1%) asymptomatic patients who were without anticoagulation ($P < 0.001$).

LIMITATIONS

The main restriction was small size of the sample.180 patients were taken into consideration and were enrolled in this study due to unfinished data and there were also different Cardiologists involved with missing case notes or exclusion criteria

CONCLUSION

Conclusively, the use of transradial PCI is not only beneficial in reduction of bleeding but also useful for ischemic complications and mortality in high-risk patients undergoing coronary interventions. The radial approach for percutaneous coronary artery interventions brings a number of additional benefits, in terms of significant improvement in patient comfort, the ability to quickly recover after the procedure, shorter hospital stay and lower costs of treatment.

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