



Assessing the Viability of Using Radial Artery Access for Primary Angioplasty and Doing a Subgroup Analysis on High-Risk Patients - A Significant Change in Approach

Dr. Himanshu Gupta¹, Dr. Krishna Kumar Sahani², Dr. Mohit Mohan Singh³, Dr. Ganesh Seth⁴, Dr. Ayushi Gupta⁵

^{1,4}Senior Consultant Medanta Hospital, Lucknow, India

²Consultant, Department of Cardiology Apollomedics Hospital, Lucknow, India

³Consultant Apollomedics Hospital, Lucknow, India

⁵Assistant Professor, Department of Anesthesia, Hind Institute of Medical Sciences, Barabanki, India

Corresponding author: Dr. Himanshu Gupta, Senior Consultant Medanta Hospital, Lucknow, India

(Received: 07 January 2024)

Revised: 12 February 2024

Accepted: 06 March 2024)

KEYWORDS

HRG, NON-HRG, Radial artery, PCI

ABSTRACT:

Aim:Assessing the viability of using radial artery access for primary angioplasty and doing a subgroup analysis on high-risk patients.

Materials and methods: The study consisted of 100 patients who were diagnosed with acute ST-segment elevation myocardial infarction (STEMI) and had percutaneous coronary intervention (PCI) via the radial artery (RA) at the cardiology department. Patients were hospitalized and assessed for initial features such as medical history, physical examination, and diagnostic tests including ECG, 2D echo, and normal laboratory investigation. Subsequently, the patients were categorized into two distinct groups, namely Group A (HRG) and Group B (non HRG), in order to conduct a more detailed study of subgroups.

Results:The average systolic blood pressure of the patients upon presentation was 141.03 ± 8.34 mmHg, whereas the average diastolic blood pressure was 84.21 ± 5.54 mmHg. The study group had a total ischaemic time of 6.53 ± 1.44 hours. Upon analyzing the ECG, it was observed that 50% of the cases exhibited AWM. Additionally, 5% of the cases showed a pattern known as QRBBB, while 51% IWMI. Furthermore, 4% of the cases presented with RVMI. During the echocardiography examination, it was found that 23% of the individuals had a satisfactory left ventricular (LV) function, with a left ventricular ejection fraction (LVEF) more than 50%. Additionally, 40% had a mild LV systolic dysfunction, with an LVEF ranging from 40% to 50%. Furthermore, 17% had a moderate LV systolic dysfunction, with an LVEF ranging from 30% to 40%. Lastly, 20% had a severe LV systolic dysfunction, with an LVEF less than 30%.

Conclusion: When comparing HRG and NON-HRG, there were more difficulties in HRG, however the difference was not statistically significant (p value > 0.05). There was no notable disparity in procedural factors between the two groups.



INTRODUCTION

Individuals suffering from coronary artery disease often experience symptoms such as chest discomfort or difficulty breathing. Current clinical recommendations recommend doing coronary angiography, which is considered the most reliable method for detecting and evaluating coronary artery stenoses, in patients with stable or unstable CAD.¹⁻⁴ Revascularization therapy is recommended for individuals who have acute coronary syndrome or verified substantial narrowing of the coronary arteries that does not improve with the best available medical treatment or causes considerable limitations in physical activity. Percutaneous coronary intervention, launched in the 1990s, is now widely used as a revascularization technique for the majority of patients with coronary artery disease, serving as an alternative to coronary artery bypass graft surgery. The conventional method for coronary angiography (CA) and PCI has often used accessing the femoral artery due to its wide diameter, which facilitates straightforward entry. Hemorrhaging is the prevailing complication of PCI and is linked to unfavorable clinical results.⁵ Angioplasty has been performed using many approaches, each with different percentages of success in clinical settings. Angioplasty procedures provide distinct merits and drawbacks based on individual proficiency. Each access is often based on the operator's desire. The use of a transradial route instead of a femoral artery (FA) method for PCI has gained popularity because to its lower incidence of bleeding problems, improved patient comfort, earlier ability to walk, and shorter hospitalization duration.^{6,7} This method has been effectively used in primary percutaneous coronary intervention for acute myocardial infarction. There has been a significant shift in the practice of using radial

artery access, even for patients who are at a high risk. The paradigm change has enabled the assessment and comparison of the risk assessment for primary angioplasty in a diverse range of patients with different risk factors and circumstances. The clinical investigation aims to assess and compare the accessibility and other relevant aspects for the effective use of RA in various circumstances. The research aims to assess and compare the practicality of regularly using RA in primary PCI, as well as in the High Risk Group and non-HRG subgroups.⁸⁻¹⁰ The objective was to determine the clinical and procedure-related factors that are linked to increased incidence of complications. The criteria considered were the baseline characteristics, complications, procedure-related aspects such as fluoroscopy duration, contrast volume, and angioplasty success rate.

MATERIALS AND METHODS

The research was conducted in a prospective manner, meaning that it looked forward in time. It was also observational, meaning that it observed and recorded data without intervening or manipulating any variables. Furthermore, the study was descriptive, meaning that it aimed to describe and analyze the characteristics and patterns of the observed phenomena. The study consisted of 100 patients who were diagnosed with acute ST-segment elevation myocardial infarction (STEMI) and had percutaneous coronary intervention (PCI) via the radial artery (RA) at the cardiology department. The choice between the RA or FA strategy was made by the interventionist. This research excluded patients who received percutaneous coronary intervention (PCI) via the femoral artery. The research protocol received approval from the Institutional Ethics Committee.



Patients were hospitalized and assessed for initial features such as medical history, physical examination, and diagnostic tests including ECG, 2D echo, and normal laboratory investigation. Subsequently, the patients were categorized into two distinct groups, namely Group A (HRG) and Group B (non HRG), in order to conduct a more detailed study of subgroups. The HRG consisted of patients with unfavorable characteristics, including individuals aged over 65, those experiencing cardiogenic shock, severe left ventricular systolic dysfunction, high degree AV block, low body surface area, multi-vessel PCI, diabetes mellitus, low body mass index. The non-HRG group encompassed all other patients not included in the HRG. The procedure parameters, complications, and results have been evaluated, organized, and examined using descriptive analysis.

METHODOLOGY

The interventionist often favored the right radial artery for transradial PCI. Following the administration of local anesthetic, individuals with RA underwent puncture, and a radial artery sheath with a diameter of 5 or 6 French (Fr) was implanted. Upon the introduction of the sheath, a dosage of 5000 units of heparin was delivered. Following the diagnostic procedure, an extra dose of 2500 units of heparin was given just before to commencing percutaneous coronary intervention. Typically, a Tigar catheter is used to try engagement of either the

left or right coronary artery for diagnostic angiography. The EBU, JL, and JR catheters were used as guiding catheters. After the percutaneous coronary intervention, the arterial access sheaths were taken out and hemostasis was accomplished using manual compression. Patients were allowed to start walking early provided they were stable in terms of their blood circulation and did not have any issues. The baseline features and procedure factors of all patients' data were assessed. Patients were systematically monitored until they were released from the hospital, and any issues that occurred during their stay were recorded.

STATISTICAL ANALYSIS

SPSS version 24.0 was used for statistical analysis. The data were presented as the mean, standard deviation (SD), or percentage (%). A comparative analysis was conducted within the patient group to assess the efficacy of RA. A probability value below 0.05 was deemed statistically significant.

RESULTS

Among the 100 consecutive patients examined, men accounted for 81% of the total. Of these guys, 26% were under the age of 45, while 7% were over the age of 65. The Body Mass Index (BMI) was computed, revealing that 7% of individuals had a BMI below 19 kg/m², whereas 18% had a BMI over 25 kg/m² (Table-1).

Table1:Basic parameter of the participants

	Group A(HRG)	Group B(Non HRG)	Total	Percentage	
Gender					0.21
Male	40	41	81	81	



Female	10	9	19	19	
Age					0.14
Below 35	4	3	7	7	
35-45	10	9	19	19	
45-55	19	20	39	39	
55-65	13	15	28	28	
Above 65	4	3	7	7	
Mean Age	47.78±5.12	48.78±6.43			
BMI					0.11
Underweight(<19)	5	2	7	7	
Normal(19-25)	35	40	75	75	
Overweight(>=25)	10	8	18	18	

Most patients exhibited one or more risk factors for CAD, with diabetes mellitus present in 43% of cases, systemic hypertension in 40%, and smoking in 27% (Table-2).

Table2:Morbidityprofile

Risk factors	Group A(HRG)	GroupB(Non HRG)	Total	Percentage
DM	23	20	43	43
HTN	21	19	40	40
DLP	7	5	12	12
H/O vascular disease	4	4	8	8
F/H/O premature CAD in family	3	4	7	7
Smoking	9	18	27	27

The average systolic blood pressure of the patients upon presentation was 141.03 ± 8.34 mmHg, whereas the average diastolic blood pressure was 84.21 ± 5.54 mmHg. The study group had a total ischaemic time of 6.53 ± 1.44 hours. Upon analyzing the ECG, it was observed that 50% of the cases exhibited AWMI. Additionally, 5% of the cases showed a pattern known as QRBBB, while 51% IWMI. Furthermore, 4% of the cases presented with RVMI. During the echocardiography examination, it was found that 23%

of the individuals had a satisfactory left ventricular (LV) function, with a left ventricular ejection fraction (LVEF) more than 50%. Additionally, 40% had a mild LV systolic dysfunction, with an LVEF ranging from 40% to 50%. Furthermore, 17% had a moderate LV systolic dysfunction, with an LVEF ranging from 30% to 40%. Lastly, 20% had a severe LV systolic dysfunction, with an LVEF less than 30%.

Prior to the operation, the coronary angiography revealed SVD in 41% of patients, DVD in 32% of



patients, TVD in 25% of patients, and LMCA involvement in 2% of patients. DES was used in the majority of patients (85%), whilst the remaining patients had BMS, POBA, or thrombo-suction procedures. Following the surgery, 85% of patients attained TIMI 3 flow, 13% achieved TIMI 2 flow, and just 2% reached TIMI 1 flow.

Approximately 87% of the patients underwent the treatment with a fluoroscopy time of less than 10 minutes. The contrast volume administered during the operation was less than or equal to 100 ml in 85% of patients, between 100 and 150 ml in 9% of patients, and more than 150 ml in the remaining patients (Table 3).

Table3:Proceduralparameters

	Group A(HRG)	Group B (Non HRG)	Total	Percentage	Pvalue
TIMI FLOW					
Grade1	1	1	2	2	0.14
Grade2	8	5	13	13	
Grade3	41	44	85	85	
FLUOROSCOPY TIME					
<10	42	45	87	87	0.22
>=10	8	5	13	13	
Mean	6.44±4.18	6.34±3.55			
CONTRAST VOLUME (ML.)					
<=100	44	41	85	85	0.16
100-150	4	5	9	9	
>150	2	4	6	6	
Mean	110.27±27.78	112.32±29.37			

Patients were monitored until they were released from the hospital, and any issues that occurred during their stay were recorded. Complications were absent in 81% of the individuals. Local effects were infrequent, with a minor haematoma seen in 3 individuals. Systemic problems were seen in 16% of the individuals. Among them, AKI is the most prevalent, accounting for 43.75%. The majority of cases of AKI were attributed to contrast-induced nephropathy, with 12.5% of patients having preexisting CKD. All of the patients except one, who had chronic kidney disease and required dialysis, recovered from acute kidney

injury (AKI). During the hospital stay, 1 patient (6.25%) had an acute stroke, while another patient had a transient ischemic attack (TIA). During the post-procedure interval, three patients had resuscitated cardiac arrest with primary ventricular tachycardia/ventricular fibrillation. The information is shown in Table 4.

Out of 100 patients in the study, 50 patients were in HRG. No statistically significant difference was found in procedural variables (fluoroscopy time, TIMI flow, contrast volume) and complications (p value >0.05) after comparison



with non-HRG. Among complications acute pulmonary oedema and resuscitated cardiac arrest were found more commonly in HRG.

Table 4: Complications

Complications	Group A (HRG)	Group B (Non HRG)	Total	Percentage
None	40	41	81	81
With local complications	1	2	3	3
With systemic complications	9	7	16	16
Systemic complications				
Acute Stroke and TIA	1	0	1	6.25
Acute pulmonary Oedema	1	0	1	6.25
AKI	3	4	7	43.75
AKI with Arrhythmia	1	0	1	6.25
AKI on CKD	1	1	2	12.5
AKI with Cardiac Tamponade	1	0	1	6.25
Resuscitated cardiac Arrest	1	2	3	18.75

DISCUSSION

After percutaneous coronary intervention (PCI), the radial technique is linked to a decrease in problems due to vascular access.^{11,12} Existing research indicates that performing primary angioplasty via the radial route reduces mortality, bleeding risk, and complications in the treatment of ST-elevation myocardial infarction (STEMI). These findings align with the results of our study. Several studies have shown that patients who had PCI via the RA have shorter hospital stays and fewer days in the coronary care unit due to a lower risk of complications.¹³ The findings of this research do not align with our own observations throughout the investigation. The majority of our patients were released from the hospital within a period of 3 to 5 days after the treatment, assuming there were no complications. The current research aimed to evaluate the feasibility of radial artery for primary angioplasty in patients with

varying baseline characteristics. Subgroup analysis was conducted to compare patients with high-risk groups (HRG) to those without HRG. Although there is increasing data on this matter, there is still significant debate on the regular use of RA, due to concerns that it may impact the efficacy of angioplasty and reperfusion time in some patient populations, particularly those at high risk. This research did not find any statistically significant difference between the HRG and non-HRG groups in terms of procedural factors and complication rates. Our analysis includes the high-risk category of patients, namely those with cardiogenic shock, which was omitted in the RIVAL experiment. Nevertheless, the outcomes and problems were similar to those seen in the RIVAL research. Various studies and meta-analyses have shown a preference for employing FA in the treatment of HRG.¹⁰



In the Indian context, the use of RA is still seen as a challenging process due to the extended period of time required to master it, as shown by previous research. Only a small number of Indian studies have been published that use RA for PCI, and none of these studies have taken into account the different HRG patients.¹²⁻¹⁴ Our research exclusively focused on examining and analyzing subgroups within the HRG category and effectively contrasted them with non-HRG groups across several characteristics. The research conducted by Francisco J, et al., in 2016 reported the findings of a percutaneous coronary intervention performed on 1029 patients. It was observed that over 93% of the PPCI procedures used RA.¹⁵ In this investigation, all of our cases were conducted using RA. The research demonstrated a success rate of around 96% for angioplasty, with just 3.0% requiring crossover. However, our study had a higher success rate of 98%. The research found that the use of RA did not have an impact on the success rate of angioplasty or reperfusion duration. However, there was a greater incidence of switching to FA (10.9% vs 2.6%; $P=0.006$) in a subgroup that had fewer favorable outcomes. However, our investigation found that even in HRG, the procedural success rate was equivalent to that of non-HRG cases.¹³ The current investigation did not find any statistically significant variations in procedural parameters, such as TIMI flow, fluoroscopy duration, and contrast volume, when comparing HRG with non-HRG. When comparing HRG with non-HRG, there were greater systemic problems in the HRG group, but no statistically significant difference was detected. Of all the systemic complications, AKI was the most prevalent. Elderly individuals above the age of 65 had a higher prevalence of systemic problems compared to those under the age of 55. There were

increased complications in patients with higher Killip class, as anticipated. The complication rate was similar to those of previous significant trials on RA PCI.¹⁵ The current research shown that primary percutaneous coronary intervention (PCI) via the radial artery (RA) is a viable option for all patients, even those with high-risk conditions. Our literature search did not uncover any comprehensive research that directly compared the HRG with non-HRG in the context of RA. None of the available research evaluated and contrasted all the criteria pertaining to high-risk categories. There is ample data indicating that patients who have periprocedural bleeding have a worse prognosis, including longer hospital stays and higher fatality rates. While problems are often rare, many studies have shown that RA is linked to a reduced likelihood of developing such complications compared to FA, without any negative impact on reperfusion duration. The current research shown that primary PCI via the RA is a viable option for regular treatment in all patients, regardless of their initial features. This approach yields comparable success rates in high-risk groups (HRG) when compared to non-HRG. One of the drawbacks of our research is the short length of follow-up, since we only observed the patients throughout their hospital stay. Additionally, the decision to perform RA on patients was left to the discretion of the operator, and the sample size was rather small. The research did not include any comparison with alternative access methods, such as femoral artery (FA), since the majority of cases in our facility are performed using radial artery (RA) access.

CONCLUSION

When comparing HRG and NON-HRG, there were more difficulties in HRG, however the difference was



not statistically significant (p value > 0.05). There was no notable disparity in procedural factors between the two groups. The findings of this research endorse the regular use of RA in all kinds of patients, including those with high-risk features. We suggest prioritizing the quick dissemination of knowledge in RA, since the learning curve for RA is greater than that for FA. RA is likely to become the preferred method of accessing all PCI (including HRG) in the near future. Based on our research on the Indian subcontinent, we strongly propose adopting RA as the primary mode of access.

REFERENCES

1. Manzoor M. To study the paradigm shift demonstrating the feasibility of using the radial artery for primary angioplasty and the evaluation of high-risk subgroups. *Journal of Cardiovascular Disease Research*. 2022;13(8):3029-36.
2. Bajraktari G, Rexhaj Z, Elezi S, Zhubi-Bakija F, Bajraktari A, Bytyçi I, Batalli A, Henein MY. Radial Access for Coronary Angiography Carries Fewer Complications Compared with Femoral Access: A Meta-Analysis of Randomized Controlled Trials. *J Clin Med*. 2021 May 17;10(10):2163. doi: 10.3390/jcm10102163. PMID: 34067672; PMCID: PMC8156941.
3. Sharma R, Ravi M, Unni G, Benjamin B, Krishnan P K C, Feasibility of Radial artery access for primary angioplasty and high risk subgroup analysis-A paradigm shift. *International Journal of Health and Clinical Research*, 2021;4(23): 262-265
4. Stone G W, Witzenbichler B, Guagliumi G, Peruga J Z, Brodie B R, Dudek D, et al. "RA in patients with ST-segment elevation myocardial infarction undergoing primary angioplasty in acutemyocardialinfarction: the HORIZONS-AMI trial". *EuroIntervention*. 7 (2011):905-916.
5. Jolly SS, Lewis BS, Avezum A. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomised, parallel group, multicentre trial. *The Lancet*. 2011;377(9775):1409-20.
6. Chase AJ, Fretz EB, Warburton WP, Klink WP, Carere RG, PiD, Berry B, Hilton JD. Association of the arterial access site at angioplasty with transfusion and mortality: the MORTAL study (Mortality benefit Of Reduced Transfusion after percutaneous coronary intervention via the Arm or Leg). *Heart*. 2008 Aug 1;94(8):1019-25.
7. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, Politi L, Rigattieri S, Pendenza G, Summaria F, Patrizi R, Borghi A, Di Russo C, Moretti C. Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study. *Journal of the American College of Cardiology*. 2012;60(24):2481-9.
8. Vora AN, Rao SV. Same day discharge following transradial PCI in India: Creating value for patients and providers. *Indian heart journal*. 2015 Mar;67(2):90.
9. Goel PK, Jatin S, Khanna R, Pandey CM. Left main PCI: an observational analysis from a large single-centre experience. *Indian heart journal*. 2016;68(1):36-42.
10. Chugh SK. Trans-radial interventions—



- From 'Bandwagon' to 'Movement': Where we were; where we are and where do we go from here. *Indian heart journal*. 2015 Nov;67(6):627.
11. Basu D, Singh PM, Tiwari A, Goudra B. Meta-analysis comparing radial versus femoral approach in patients 75 years and older undergoing percutaneous coronary procedures. *Indian heart journal*. 2017;69(5):580-8.
 12. Gokhroo RK, Kaushik SK, Padmanabhan D, Bisht D, Gupta S. A single center multioperator initial experience of 4195 patients at a primary radial intervention program in a tertiary level center. *Indian heart journal*. 2014 Mar 1;66(2):169-75.
 13. Valgimigli M, Gagnor A, Calabró P, Frigoli E, Leonardi S, Zaro T, Limbruno U. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomised multicentre trial. *The Lancet*. 2015;385(9986):2465-76.
 14. Bernat I, Horak D, Stasek J, Mates M, Pesek J, Ostadal P, Hrabos V, Dusek J, Koza J, Sembera Z, Brtko M. ST-segment elevation myocardial infarction treated by a radial or femoral approach in a multicenter randomized clinical trial: the STEMI-RADIAL trial. *Journal of the American College of Cardiology*. 2014;63(10):964-72.
 15. Hernández-Pérez FJ, Blasco-Lobo A, Goicolea L, Muñoz-Lozano A, Fernández-Díaz JA, Domínguez JR, Goicolea-Ruigómez J. Use of the radial approach in primary angioplasty: results in 1029 consecutive patients and analyses in unfavorable subgroups. *Revista Española de Cardiología (English Edition)*. 2014 Jan 1;67(1):45-51.