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Comparison of the clinical characteristics and in hospital outcomes of proximal versus non-proximal lesions in dominant right coronary artery ST-elevation myocardial Infarction.

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Abstract

Background: Right coronary artery (RCA) ST-elevation myocardial infarction (STEMI) is a critical cardiovascular condition that can lead to significant morbidity and mortality if not treated promptly. Primary percutaneous coronary intervention (PCI) is the gold standard for managing STEMI patients. The objective of this study is to evaluate clinical characteristics and outcome of proximal versus non-proximal, in dominant "right coronary artery (RCA) ST-elevation myocardial infarction (STEMI)" patients undergoing primary PCI at NICVD, Karachi.

Methodology: This retrospective comparative cross-sectional study included equal number of consecutive patients diagnosed with dominant "RCA STEMI" with culprit proximal and non-proximal lesions undergoing primary PCI. In-hospital clinical outcomes including mortality, heart failure, cardiogenic shock, ventricular arrhythmias, myocardial infarction, stent thrombosis, AV block, TPM placement, IABP placement, and other procedure-related complications were compared between the two groups.

Results: Total 355 patients each with proximal lesions and non-proximal lesions were included. Age was similar between the two groups, with no significant difference observed (56.9 ± 10.8 years vs. 56 ± 10.4 years; p = 0.367). Pre-procedure TIMI flow was significantly worse in the proximal lesion group compared to the non-proximal lesion group (TIMI 0: 70.1% vs. 66.8%; p = 0.015). Delay in PCI was noted for 107 (30.2%) vs. 68 (19.2%); p=0.001in proximal compared to the non-proximal group, respectively.

Conclusion: Proximal lesions appear to be associated with poorer initial coronary blood flow and a higher likelihood of in-hospital mortality. Further, a significant delay in intervention was observed for proximal group. Hence, these findings revealed the importance of timely intervention and tailored management strategies based on lesion location in optimizing outcomes for STEMI patients.

Keywords

STEMI, PCI, Proximal, Non-Proximal, Dominant RCA.

Introduction

"ST-elevation myocardial infarction (STEMI)" remains a significant cause of mortality and morbidity worldwide, so need of urgent intervention to restore coronary blood flow and decrease the burden of adverse outcomes[1]. The key factors in STEMI patients include infarct size, location of lesion, and "residual left ventricular ejection fraction (LVEF)"[2]. Among these, the anatomical location of the culprit lesion has emerged as a potential prognostic indicator for both short-term and long-term outcomes[2]. The proximal versus non-proximal location is the field of great attenuation in relating to the STEMI management. In past studies involving fibrinolysis therapy showed that higher rate of hemodynamics complication and mortality are more in proximal lesion as compared with non-proximal lesion[3,4].

Now a day primary percutaneous coronary intervention (PCI) has been widely performed, so the impact of lesion location on outcome is the major subject of debate[2,4,5]. In STEMI subsets, those involving "left anterior descending (LAD)" or "dominant right coronary artery (RCA)" has indicated that there is varying association with clinical results and outcomes. Studies on LAD STEMI patients reported that higher rate of complication and mortality for the proximal lesion[3,6]. Likewise in RCA STEMI, the proximal lesion are associated with right ventricular (RV) failure and cardiogenic shock (CS) but with inconsistent correlations to mortality[6,7]. Recent research has sought to elucidate the clinical characteristics and outcomes associated with proximal versus non-proximal lesions in dominant RCA STEMI undergoing primary PCI. Femia et al.[8] conducted a study involving 939 patient and showed that cardiogenic shock, need of intra-aortic balloon pump (IABP), or temporary pacemaker (TPM) and 30 day mortality was higher in poroximal vs. non proximal lesion. Another study, Noaman S et al.[6] reported that increase rate of adverse clinical events including major "adverse cardiac events (MACE)" and "major adverse cardiac and cerebrovascular events (MACCE)" in proximal lesion location.

The local data regarding the clinical differences and outcomes of proximal versus non-proximal RCA STEMI patients remain limited, especially within the South Asian population characterized by a high burden of coronary artery disease (CAD). Given the role of the National Institute of Cardiovascular Disease (NICVD), Karachi, as a leading cardiac care center in the region, there exists a unique opportunity to address this knowledge gap and evaluate this clinical phenomenon in a diverse patient population.

Therefore, the purpose of this study is to evaluate the prognostic significance of culprit lesion location, specifically proximal versus non-proximal, in dominant RCA STEMI patients undergoing primary PCI at NICVD, Karachi. By analyzing a comprehensive dataset, this study aims to provide valuable insights into the clinical characteristics and outcomes of these patients, contributing to the optimization of STEMI management strategies in the South Asian context.

Methodology

Study Design and Setting: The study design was a retrospective comparative cross-sectional study conducted at the "National Institute of Cardiovascular Disease (NICVD" Karachi.

Participants: The participants included equal number of consecutive patients diagnosed with dominant RCA STEMI with culprit proximal and non-proximal lesions undergoing primary PCI. Patients with both proximal and non-proximal involvement were excluded from the study. The proximal and non-proximal groups were selected independently using consecutive sampling technique.

Variables: Variables of interest are risk factors, access site via radial or femoral for Intervention, culprit lesion segment in RCA, TIMI flow pre and post procedure, PCI delay reason, cardiac events or cardiac devices, and in hospital mortality. Culprit lesions which are located proximal to the origin of the last Right marginal artery ≥1 mm in caliber was categorized as proximal, whereas lesions located distal to the last RV marginal artery but proximal to

the bifurcation of the RPDA and RPL branches was categorized as non-proximal.

Data Sources/Measurements: The data sources and measurements in the study included: Hospital database (NCDR Registry) records between September 2022 and September 2023. Demographic details such as age, body mass index (BMI), comorbidities, and risk factors. Angiography findings post-procedure outcomes. In-hospital clinical outcomes including mortality, heart failure, cardiogenic shock, ventricular arrhythmias, myocardial infarction, stent thrombosis, AV block, TPM placement, IABP placement, and other procedure-related complications.

Bias: In this study efforts were made to decrease the bias and it was insured the inclusion of patients without discrimination based on age, gender in a consecutive manner and used a standardized protocol for data collection from NCDR registry.

Ethics: Ethical review board permission was obtained from the institute prior to the commencement of the study (IRB:). The ammonized data was extracted for analysis in order to maintain the confidentiality of the subjects.

Study Size: This sample size was determined based on previous research reporting a mortality rate of 5.0% among patients with proximal lesions and 0.9% among those with non-proximal lesions [8]. To detect a difference between the two groups at a 5% level of significance and 80% power, a total sample size of 614 patients (307 in each group) was calculated. Therefore, the study recruited a slightly larger sample size of 710 (355 in each group) patients to ensure adequate statistical power and account for potential dropouts or missing data.

Quantitative Variables: The quantitative variables in the study included: age, body mass index (BMI), Number of patients in different age groups, pre-procedural and post-procedural TIMI (thrombolysis in myocardial infarction) flow, number of vessels. These variables were analyzed to compare clinical characteristics and outcomes between patients with proximal and non-proximal lesions in dominant RCA STEMI.

Statistical Methods: The statistical methods employed in the above study involved comparing baseline clinical characteristics and angiography findings between patients with "proximal and non-proximal lesions" in dominant right coronary artery "ST-elevation myocardial infarction". This was done using appropriate statistical tests such as Chi-square/Fisher's exact test for categorical variables and independent sample t-test/Mann Whitney U test for continuous variables, with a significance level of 5%. Data analysis was performed using SPSS version-21.

Results

Total 355 patients each with proximal lesions and non-proximal lesions were included. Age was similar between the two groups, with no significant difference observed (56.9 ± 10.8 years vs. 56 ± 10.4 years; p = 0.367). Body mass index (BMI) was slightly higher in the non-proximal lesion group in comparison to the proximal lesion group (27.6 ± 4.2 kg/m2 vs. 27.1 ± 4.5 kg/m2; p = 0.031). There were no significant differences in the presence of comorbidities such as hypertension (HTN), diabetes Mellitus, or prior cardiovascular events between the two groups (Table 1).

Table 1: Distribution and comparison of baseline clinical characteristics between patents with "proximal versus non-proximal lesions" in "dominant right coronary artery ST-elevation myocardial infarction"

		Total	Segment		P-value
			Proximal	Non Proximal	
Total (N)		**710**	**355**	**355**	-
Gender	Male	535 (75.4%)	258 (72.7%)	277 (78%)	0.098

	Female	175 (24.6%)	97 (27.3%)	78 (22%)	
Age (year)	Mean ± Sta. Dev	56.4 ± 10.6	56.9 ± 10.8	56 ± 10.4	0.367
	< 40 Years	77 (10.8%)	37 (10.4%)	40 (11.3%)	0.165
	40 to 65 Years	512 (72.1%)	248 (69.9%)	264 (74.4%)	
	> 65 Years	121 (17%)	70 (19.7%)	51 (14.4%)	
Body mass index (kg/m^2)	Mean ± Sta. Dev	27.4 ± 4.3	27.1 ± 4.5	27.6 ± 4.2	0.031
	Underweight	1 (0.1%)	1 (0.3%)	0 (0%)	0.285
	Normal Weight	183 (25.8%)	101 (28.5%)	82 (23.1%)	
	Overweight	144 (20.3%)	68 (19.2%)	76 (21.4%)	
	Obese	382 (53.8%)	185 (52.1%)	197 (55.5%)	
Comorbidities	Hypertension	393 (55.4%)	209 (58.9%)	184 (51.8%)	0.059
	Diabetes	232 (32.7%)	106 (29.9%)	126 (35.5%)	0.109
	Family history of CAD	3 (0.4%)	1 (0.3%)	2 (0.6%)	0.563
	History of MI	47 (6.6%)	27 (7.6%)	20 (5.6%)	0.290
	Prior CABG	2 (0.3%)	2 (0.6%)	0 (0%)	0.157
	History of CVD	8 (1.1%)	4 (1.1%)	4 (1.1%)	>0.999
	Prior PCI	42 (5.9%)	25 (7%)	17 (4.8%)	0.203
Tobacco Use	No	4 (0.6%)	2 (0.6%)	2 (0.6%)	0.806
	Current - Every Day	90 (12.7%)	49 (13.8%)	41 (11.5%)	
	Current - Some Days	1 (0.1%)	1 (0.3%)	0 (0%)	
	Former	19 (2.7%)	10 (2.8%)	9 (2.5%)	
	Never	593 (83.5%)	291 (82%)	302 (85.1%)	
	Unknown if ever smoked	3 (0.4%)	2 (0.6%)	1 (0.3%)	
Tobacco Type	Cigarettes	75 (10.6%)	40 (11.3%)	35 (9.9%)	0.541
	Pipe	3 (0.4%)	3 (0.8%)	0 (0%)	0.083
	Smokeless	13 (1.8%)	7 (2%)	6 (1.7%)	0.779

The majority of patients underwent radial route for the procedure, with no significant difference between the "proximal and non-proximal lesion" groups (p = 0.085). Pre-procedure TIMI flow was significantly worse in the proximal lesion group compared to the non-proximal lesion group (TIMI 0: 70.1% vs. 66.8%; p = 0.015). Post-procedure TIMI flow was good in both groups, with no significant difference observed (p = 0.94). There is significantly higher proportion of patient with non-proximal lesion were discharged alive compared to those with proximal lesion (98.3% vs. 95.8%; p = 0.046), (Table 2).

There were no differences in the occurrence of cardiac events such as cardiac arrest, cardiogenic shock, or heart failure between the two groups. The use of cardiac devices such as TPM and IABP was similar between the two groups (Table 2).

Table 2: Distribution and comparison of angiography findings post-procedure outcomes between patents with "proximal versus non-proximal lesions" in "dominant right coronary artery ST-elevation myocardial infarction".

Study Variables		Total	Segment		P-value
			Proximal	Non Proximal	
Total (N)		**710**	**355**	**355**	-
Access site	Radial	522 (73.5%)	249 (70.1%)	273 (76.9%)	0.085
	Femoral	187 (26.3%)	105 (29.6%)	82 (23.1%)	
	Brachial	1 (0.1%)	1 (0.3%)	0 (0%)	
	Other	0 (0%)	0 (0%)	0 (0%)	
Coronary artery disease	Left main	19 (2.7%)	11 (3.1%)	8 (2.3%)	0.485
	Left anterior descending artery	388 (54.6%)	192 (54.1%)	196 (55.2%)	0.763
	Left circumflex artery	322 (45.4%)	165 (46.5%)	157 (44.2%)	0.546
Number of vessels	Single vessel disease	238 (33.5%)	118 (33.2%)	120 (33.8%)	0.983
	Two vessel disease	240 (33.8%)	120 (33.8%)	120 (33.8%)	
	Three vessel disease	232 (32.7%)	117 (33%)	115 (32.4%)	
Pre-procedure thrombolysis in myocardial infarction flow	0	486 (68.5%)	249 (70.1%)	237 (66.8%)	0.015
	I	60 (8.5%)	23 (6.5%)	37 (10.4%)	
	II	103 (14.5%)	44 (12.4%)	59 (16.6%)	
	III	61 (8.6%)	39 (11%)	22 (6.2%)	
Post-procedure thrombolysis in myocardial infarction flow	0	2 (0.3%)	1 (0.3%)	1 (0.3%)	0.94
	I	5 (0.7%)	2 (0.6%)	3 (0.8%)	
	II	5 (0.7%)	3 (0.8%)	2 (0.6%)	
	III	698 (98.3%)	349 (98.3%)	349 (98.3%)	
Segment right coronary artery	Proximal	155 (21.8%)	155 (43.7%)	0 (0%)	-
	Mid	244 (34.4%)	244 (68.7%)	0 (0%)	-
	Distal	355 (50%)	0 (0%)	355 (100%)	-
PCI delay	Mean ± Sta. Dev	175 (24.7%)	107 (30.2%)	68 (19.2%)	0.001
	Patient delays in providing consent for PCI	27 (15.4%)	23 (21.5%)	4 (5.9%)	0.005
	Difficult Vascular Access	0 (0%)	0 (0%)	0 (0%)	
	Other	148 (84.6%)	84 (78.5%)	64 (94.1%)	
Cardiac events	Cardiac Arrest	19 (2.7%)	13 (3.7%)	6 (1.7%)	0.103
	Cardiogenic Shock	8 (1.1%)	5 (1.4%)	3 (0.8%)	0.477
	Heart Failure	6 (0.8%)	5 (1.4%)	1 (0.3%)	0.101
	Stroke – Undetermined	1 (0.1%)	0 (0%)	1 (0.3%)	0.317
Cardiac devices	Temporary pacemaker	12 (1.7%)	7 (2%)	5 (1.4%)	0.56

	Intra-aortic balloon pump	1 (0.1%)	1 (0.3%)	0 (0%)	0.317
Discharge Status	Alive	689 (97%)	340 (95.8%)	349 (98.3%)	0.046
	Deceased	21 (3%)	15 (4.2%)	6 (1.7%)	

Discussion

The finding of our study highlighted the clinical characteristics and outcomes of patients with proximal versus non-proximal lesions in dominant RCA STEMI who underwent primary PCI. Our study revealed that patients with proximal lesions have relatively higher (but insignificant) rates of comorbidities such as hypertension and diabetes compared to those with non-proximal lesions. This results also aligns with previous studies highlighting the association between proximal lesion location and the presence of cardiovascular risk factors[3,6]. Our analysis showed that higher BMI is more common in proximal vs. non proximal (p = 0.031). This finding suggests that there is potential link between proximal lesion location and obesity, which could be researched in future studies. No significant differences in the distribution of coronary artery disease among patients with proximal and non-proximal lesions. This suggests that the severity and extent of coronary artery disease may not differ based on lesion location within the RCA. Surprisingly, our analysis showed that patients with proximal lesions were more likely to experience delays in providing consent for PCI compared to those with non-proximal lesions. So the delay in initiation of treatment in these patient have a large effect on outcome. Early recognition of lesion location is crucial for guiding treatment decisions. Aggressive management strategies should be employed for patients with proximal lesions to improve clinical outcomes. Efforts should be made to minimize delays in obtaining consent for percutaneous coronary intervention (PCI), especially in high-risk patients with proximal lesions. In post-procedure outcomes, our study found no significant differences in cardiac events such as cardiac arrest, cardiogenic shock, and heart failure between patients with "proximal and non-proximal lesions".

However, Femia et al. found that patient treated with primary and rescue PCI having proximal lesions more develop cardiogenic shock and they need of IABP or TPM placement and also had higher 30-day mortality and lower 1–2-year survival as compared with non-proximal lesion[7].

Harjai et al. compared the PCI result for "proximal and non-proximal RCA" culprit and found that proximal lesion undergoes unplanned IABP support and TPM support even no significant blood pressure difference[8].

In another study Goldstein et al found symptomatic Brady arrhythmia and hypotension were more common in "proximal RCA" occlusion after underwent primary PCI[10]. Therefore, the higher rate of hemodynamic complications among these patients may be due to RV marginal artery occlusion resulting in RV infarction, reduced pulmonary blood flow leading to reduced LV cardiac output[9,10]. However, there was a higher incidence of in-hospital mortality among patients with proximal lesions compared to those with non-proximal lesions. This finding is consistent with previous studies reporting worse outcomes associated with proximal lesion location[6,8].

There are some limitations of this study, firstly, it is a retrospective study, and it is subject to inherent biases and confounders. Secondly, our study was conducted at a single center, which may limit the generalizability of our findings to other populations. In conclusion, our study provides valuable information regarding clinical characteristics and outcomes of patients with proximal versus non-proximal lesions in dominant RCA STEMI undergoing PCI. In future prospective studies with larger sample sizes are warranted to validate our results and explore mechanisms underlying the observed associations.

Conclusion

In summary, the analysis reveals several important insights into the angiographic characteristics and

outcomes of "proximal versus non-proximal lesions" in "dominant RCA STEMI". Proximal lesions appear to be associated with poorer initial coronary blood flow and a higher likelihood of in-hospital mortality. Further, a significant delay in intervention was observed for proximal group. Hence, these findings revealed the importance of timely intervention and tailored management strategies based on lesion location in optimizing outcomes for STEMI patients.

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