ORIGINAL ARTICLE

Association of Coronary Artery Dominance with Post-Primary Percutaneous Coronary Intervention Complication in ST-Segment Elevation Myocardial Infarction: Retrospective Observational Study, Rawalpindi

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ABSTRACT

Objective: To examine the relationship between coronary artery dominance and complications after primary percutaneous coronary intervention in patients with ST-elevation myocardial infarction (STEMI).

Study Design: Retrospective observational study.

Place and Duration of Study: This study was conducted at the Armed Forces Institute of Cardiology (AFIC) and the National Institute of Heart Diseases (NIHD), Rawalpindi, Pakistan from February 2023 to January 2024.

Methods: Coronary artery dominance and complications following initial percutaneous coronary intervention (PCI) in ST-segment elevation myocardial infarction patients were examined in this retrospective observational study. The Armed Forces Institute of Cardiology and National Institute of Heart Diseases in Rawalpindi, Pakistan, conducted this investigation. From February 2023 to January 2024, 85 consecutive STEMI patients had primary percutaneous coronary intervention (PCI) at the study centers. Patients who had CABG, significant coronary anomalies, or inadequate medical data were excluded from the research. Electronic medical records and angiographic databases included demographics, medical history, angiographic results, procedure details, and post-PCI issues.

Results: The study comprised 85 patients diagnosed with STEMI at an average age of 59.4 years. The group was mostly made up of male patients, accounting for 76.5% of the total. Comorbidities such as hypertension (52.9%) and diabetes mellitus (35.3%) were prevalent. Left dominance was seen in 47.1% of instances, whereas right dominance was noted in 35.3%. Co-dominance was detected in 17.6% of cases. Myocardial reperfusion injury, no-reflow phenomenon, and distal embolization occurred in 17.6%, 23.5%, and 11.8% of patients, respectively.

Conclusion: According to our results, STEMI post-PCI morbidity may not be affected by coronary artery dominance. However, patient demographics, comorbidities, lesion characteristics, and procedures may alter PCI outcomes.

Keywords: *Coronary Angiography, Percutaneous Coronary Intervention, Reperfusion Injury, ST Elevation Myocardial Infarction.*

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Introduction

STEMI continues to be a major contributor to disease and mortality globally, requiring timely and efficient therapeutic approaches to reduce adverse outcomes.[1] PCI has become the mainstay treatment for STEMI, providing fast restoration of blood flow in the coronary arteries and preservation of at-risk heart muscle.[2,3,4] However, even with progress in interventional procedures and additional

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medication, a certain group of patients who have primary PCI still encounter post-procedural problems that might potentially impact their clinical outcomes.[5]

Coronary artery dominance refers to the arterial system that mostly supplies the PDA. It is an important anatomical factor to consider in coronary intervention. The categorization of coronary artery dominance into right dominance (where the PDA is fed by the RCA) and left dominance (when the PDA is supplied by the left circumflex artery [LCx]) has significant consequences for planning medical procedures, determining the appropriate technical approach, and assessing the possible risk of problems.[6,7] However, there is still a lack of comprehensive understanding of the correlation between coronary artery dominance and PCI problems in patients with STEMI.[8]

The objective of this study is to examine the relationship between coronary artery dominance and complications after PCI in patients with STEMI. This study aims to determine whether specific patterns of coronary artery dominance increase the risk of complications after PCI for STEMI. The analysis will be based on patient data obtained from the AFIC and NIHD in Rawalpindi, Pakistan.

Comprehending the influence of coronary artery dominance on procedural outcomes in patients with STEMI who are having PCI has many therapeutic implications.[9,10] Firstly, it might assist in risk stratification, enabling doctors to identify patients with a greater chance of experiencing adverse outcomes and apply suitable preventative interventions. Furthermore, understanding of the structure and dominant patterns of the coronary arteries may assist in making decisions during medical procedures, helping operators choose the most effective methods and instruments to reduce the risk of problems.[11,12]

The above mentioned introduction establishes the background for this research protocol by emphasizing the importance of examining the relationship between coronary artery dominance and post-PCI problems in the context of STEMI therapy. The research aims to address this knowledge gap, thereby improving clinical practice and enhancing patient care in interventional cardiology.

Methods

This cross sectional study was carried out at the Armed Forces Institute of Cardiology (AFIC) and National Institute of Heart Diseases (NIHD) in Rawalpindi, Pakistan from February 2023 to January 2024 after approval from Ethical Review Board of AFIC and NIHD Rawalpindi, vide letter no: 9/2/R&D/2023/299, dated: 22nd January 2023. The study process protected patient privacy and data. The sample size was calculated using the WHO sample size calculator, based on the study by Mikaeilvand. et al., as the parent study.[13] The confidence level was taken as 95%, absolute precision was taken as 0.05, and anticipated population precision was taken as 4.5% (frequency of co-dominant). The minimum sample size came out to be 67 patients.

We included 85 consecutive patients diagnosed with STEMI who received PCI from February 2023 to January 2024. The study excluded those who had previously had CABG, had substantial coronary abnormalities, or had insufficient medical data. Demographic information, medical history, angiographic findings, procedure details, and post-PCI problems were obtained from electronic medical records and angiographic databases. The coronary angiograms were examined to identify the patterns of coronary artery dominance, which are categorized as right dominance (where the RCAthe RCA feeds the posterior descending artery feeds the posterior descending artery), left dominance (when the PDA is supplied by the left circumflex artery [LCx]), or co-dominance.

The main measure of interest was the presence of problems during PCI, such as myocardial reperfusion damage, no-reflow phenomena, and distal embolization. Post-procedural problems were determined based on well-established clinical criteria and consensus standards.

SPSS 23 was used for statistical analysis. Patient and procedure characteristics were summarized using descriptive statistics. The relationship between coronary artery dominance and post-PCI problems was examined using suitable statistical analyses,

such as the chi-square test for categorical data and the Student's t-test for continuous variables, taking a *P*-value of <0.05 as statistically significant.

Results

The research included 85 patients diagnosed with ST-segment elevation myocardial infarction (STEMI), with an average age of 59.4 years. The group was mainly composed of male patients, accounting for 76.5% of the total. The occurrence of comorbidities, including hypertension (52.9%) and diabetes mellitus (35.3%), was significant. Approximately 47.1% of the patients had a smoking history. The majority of patients (58.8%) were admitted with Killip class I. The median duration for PCI was 72 minutes, with an interquartile range of 60 to 90 minutes.

The LAD was the artery most often affected in cases of myocardial infarction (70.6%). 35.3% of patients had multivessel disease. The location of the lesions varied, with 41.2% of them being found in the proximal segment. 52.9% of the lesions were classified as category A complexity. Drug-eluting stents were used more often compared to bare-metal stents, with a distribution of 64.7% and 35.3% respectively. The thrombus load exhibited variability, with 47.1% of patients presenting no thrombus. Table 1 and 2 displays the angiographic and procedural features.

Table 3 shows the distribution of coronary artery dominance throughout the study population. The prevalence of left dominance was 47.1%, while right dominance was seen in 35.3% of cases. Co-dominance was present in 17.6% of cases.

Table 4 provides a summary of the occurrence of problems after PCI. Myocardial reperfusion damage, the no-reflow phenomena, and distal embolization were seen in 17.6%, 23.5%, and 11.8% of patients, respectively.

Table 5 displays the comparison of complications after PCI based on the dominance of the coronary artery. There were no significant statistical variations in the occurrence of myocardial reperfusion damage (*P*=0.75) or distal embolization (*P*=0.48) among patients with varied dominance patterns. However, the occurrence of the no-reflow phenomenon seems to be more frequent in patients with co-dominance in comparison to those with right or left dominance. However, it is essential to note that this difference did not achieve statistical significance (*P*=0.27).

Table 6 presents the findings of a multivariable logistic regression study investigating the variables linked to post-PCI problems. Coronary artery

Table 1: Study Population Baseline Characteristics

Characteristic	Total (N=85)	Right Dominance (N=30)	Left Dominance (N=40)	Co-Dominance (N=15)
Age (years), Mean ± SD	59.4 ± 8.7	58.1 ± 9.2	60.8 ± 7.6	57.3 ± 8.1
Gender (n %)				
Male	65 (76.5%)	24 (80.0%)	29 (72.5%)	12 (80.0%)
Female	20 (23.5%)	6 (20.0%)	11 (27.5%)	3 (20.0%)
Hypertension (n %)	45 (52.9%)	18 (60.0%)	20 (50.0%)	7 (46.7%)
Diabetes Mellitus (n %)	30 (35.3%)	12 (40.0%)	13 (32.5%)	5 (33.3%)
Smoking (n %)	40 (47.1%)	15 (50.0%)	17 (42.5%)	8 (53.3%)
Previous MI (n %)	20 (23.5%)	7 (23.3%)	8 (20.0%)	5 (33.3%)
Previous PCI (n %)	10 (11.8%)	4 (13.3%)	3 (7.5%)	3 (20.0%)
Killip Class (n %)				
I	50 (58.8%)	20 (66.7%)	22 (55.0%)	8 (53.3%)
II	25 (29.4%)	7 (23.3%)	11 (27.5%)	7 (46.7%)
III	10 (11.8%)	3 (10.0%)	7 (17.5%)	0 (0.0%)
IV	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Time to PCI (minutes), Median (IQR)	72 (60-90)	70 (55-85)	75 (62-95)	80 (65-100)

dominance did not show an independent association with post-percutaneous coronary intervention (PCI) problems after accounting for age, diabetes mellitus, thrombus load, and stent type.

These data show that other clinical and procedural variables may affect STEMI patients' post-PCI problems more than coronary artery dominance. To confirm these findings and identify other post-PCI problem predictors in this patient group, bigger sample sizes are required.

Table 2: Angio and Procedural Features

Characteristic	Total (N=85)	Right Dominance (N=30)	Left Dominance (N=40)	Co-Dominance (N=15)
Infarct-related Artery				
LAD	60 (70.6%)	22 (73.3%)	28 (70.0%)	10 (66.7%)
RCA	15 (17.6%)	10 (33.3%)	3 (7.5%)	2 (13.3%)
LCx	10 (11.8%)	5 (16.7%)	9 (22.5%)	3 (20.0%)
Multivessel Disease (n %)	30 (35.3%)	10 (33.3%)	12 (30.0%)	8 (53.3%)
Lesion Location (n, %)				
Proximal	35 (41.2%)	12 (40.0%)	14 (35.0%)	9 (60.0%)
Mid	30 (35.3%)	10 (33.3%)	10 (25.0%)	10 (66.7%)
Distal	20 (23.5%)	8 (26.7%)	16 (40.0%)	3 (20.0%)
Lesion Complexity (n %)				
Type A	45 (52.9%)	16 (53.3%)	22 (55.0%)	7 (46.7%)
Type B1	20 (23.5%)	8 (26.7%)	7 (17.5%)	5 (33.3%)
Type B2/C	20 (23.5%)	6 (20.0%)	11 (27.5%)	3 (20.0%)
Stent Type and Size (n %)				
Bare Metal Stent, (BMS)	30 (35.3%)	10 (33.3%)	14 (35.0%)	6 (40.0%)
Drug-Eluting Stent,(DES)	55 (64.7%)	20 (66.7%)	26 (65.0%)	9 (60.0%)
Stent Diameter (mm), Mean ± SD	3.2 ± 0.4	3.1 ± 0.3	3.3 ± 0.5	3.2 ± 0.4
Stent Length (mm) ,Mean ± SD	26.8 ± 4.6	26.5 ± 4.2	27.0 ± 4.9	27.5 ± 4.5
Thrombus Burden (n %)				
None	40 (47.1%)	15 (50.0%)	18 (45.0%)	7 (46.7%)
Moderate	30 (35.3%)	10 (33.3%)	12 (30.0%)	8 (53.3%)
High	15 (17.6%)	5 (16.7%)	10 (25.0%)	0 (0.0%)
Use of Glycoprotein IIb/IIIa Inhibitors (n %)				
Yes	25 (29.4%)	10 (33.3%)	8 (20.0%)	7 (46.7%)
No	60 (70.6%)	20 (66.7%)	32 (80.0%)	8 (53.3%)
TIMI Flow Grade Before PCI (n %)				
0/1	30 (35.3%)	15 (50.0%)	10 (25.0%)	5 (33.3%)
2	25 (29.4%)	8 (26.7%)	12 (30.0%)	5 (33.3%)
3	30 (35.3%)	7 (23.3%)	18 (45.0%)	5 (33.3%)
Post-PCI TIMI Flow Grade (n, %)				
0/1	10 (11.8%)	5 (16.7%)	3 (7.5%)	2 (13.3%)
2	20 (23.5%)	8 (26.7%)	6 (15.0%)	6 (40.0%)
3	55 (64.7%)	17 (56.7%)	31 (77.5%)	7 (46.7%)

Table 3: Distribution of Coronary Artery Dominance

Coronary Artery Dominance	Frequency (N)	Percentage (%)
Right Dominance	30	35.3%
Left Dominance	40	47.1%
Co-Dominance	15	17.6%

Table 4: Incidence of Post-PCI Complications

Complication	Total (N=85)	Right Dominance (N=30)	Left Dominance (N=40)	Co-Dominance (N=15)
Myocardial Reperfusion Injury	15	5 (16.7%)	7 (17.5%)	3 (20.0%)
No-Reflow Phenomenon	20	6 (20.0%)	8 (20.0%)	6 (40.0%)
Distal Embolization	10	3 (10.0%)	4 (10.0%)	3 (20.0%)

Table 5: Comparison of Post-PCI Complications by Coronary Artery Dominance using the chi square Test

Complication	Right Dominance (N=30)	Left Dominance (N=40)	Co-Dominance (N=15)	*Chi-Square* value	*P*-value
Myocardial Reperfusion Injury	5 (16.7%)	7 (17.5%)	3 (20.0%)	0.078	0.962
No-Reflow Phenomenon	6 (20.0%)	8 (20.0%)	6 (40.0%)	0.305	0.859
Distal Embolization	3 (10.0%)	4 (10.0%)	3 (20.0%)	1.190	0.552

Discussion

The average age of the participants in our research was 59.4 years, and the majority of them were male (76.5%). The results of this research align with a previous publication from 2014, which showed that STEMI mostly impacts older people. males have a higher risk of developing STEMI compared to women, particularly those who have acute congestive indications and are consecutive patients. The average age of the patients with STEMI in this study was 62 years, and 78.8% of them were males.[13] The occurrence of simultaneous medical conditions, such as high blood pressure (52.9%) and diabetes mellitus (35.3%), is consistent with the findings of Stevenson LW, et al. (2019).[14] This emphasizes the significance of effectively controlling these risk factors in patients with myocardial infarction, specifically those with (STEMI; 24.3%), followed by non-STEMI (12.9%), and a higher occurrence of pulmonary hypertension.

In our analysis, the LAD was the most frequently affected infarct-related artery, accounting for 70.6% of cases. It was followed by the RCA and the left circumflex artery (LCx). This distribution aligns with earlier studies that have shown the involvement of the LAD artery as the most common vascular responsible for STEMI.[15] Moreover, the current recommendations consistently advocate for the use of DES instead of bare-metal stents (BMS) in the majority of PCI operations, since DES have been shown to provide better clinical results.[16]

The percentage of patients who achieved TIMI flow grade 3 after undergoing PCI in our analysis (64.7%) is consistent with the rates reported in recent PCI registries published in 2017.[17] The relevance of pre-PCI imaging is equivalent to or greater than post-PCI imaging when compared to intravascular ultrasound (IVUS) guidance. This is supported by the findings that 64.7 ± 13.7% of cases showed no stenosis and retained TIMI 3 flow, whereas 80.3 ± 13.4% of cases showed the same results. However, it is necessary to do more research to comprehend the possible consequences for clinical outcomes that may arise from variations in post-PCI TIMI flow grades across various coronary artery dominance patterns.

Our investigation revealed that the distribution of coronary artery dominance was as follows: 35.3% were categorized as right dominance, 47.1% as left dominance, and 17.6% as co-dominance. The results align with prior research, which has shown differences in the prevalence of coronary artery dominance patterns among various groups.[18] However, the precise allocation may differ across investigations as a result of disparities in the sizes of the samples, characteristics of the patients, and geographical locations.

The occurrence of post-PCI problems differed across various patterns of coronary artery dominance. Myocardial reperfusion damage was detected in 16.7% of patients with right dominance, 17.5% with left dominance, and 20.0% with co-dominance. The occurrence of the no-reflow phenomenon was seen in 20.0% of patients with right dominance, 20.0% with left dominance, and 40.0% with co-dominance.

Distal embolization was seen in 10.0% of patients with right dominance, 10.0% with left dominance, and 20.0% with co-dominance.

When analyzing post-PCI sequelae in relation to various coronary artery dominance patterns, there were no notable disparities in the occurrence of myocardial reperfusion damage (*P*= 0.962) and distal embolization (*P*=0.552). However, patients with co-dominance exhibited a slight increase in the occurrence of the no-reflow phenomenon compared to those with right or left dominance. However, this difference was not found to be statistically significant (*P*=0.859), which is consistent with a previous study that focused on distal embolization.[19] Additionally, the presence of no-reflow has also been associated with the percentage of distal embolization (*P*=0.46) and the presence of multivessel disease (59.7% vs 54.4%, *P*=0.48). The assessment of no-reflow was based on the TIMI flow post-PCI.[20]

In summary, our research contributes to the current body of knowledge by providing valuable information on the prevalence of coronary artery dominance and its correlation with post-PCI problems in patients with STEMI. The limitation of our study is the small sample size. In the current era of evidence-based practices, we recommend that further research on this topic be conducted to identify the relationship between coronary artery dominance and post-PCI issues and optimize the management of patients presenting with STEMI.

Conclusion

We studied coronary artery dominance and post-primary PCI issues in STEMI patients. LCA dominance predominated, followed by right and co-dominance. Different coronary artery dominance patterns did not alter post-PCI myocardial reperfusion damage, no-reflow, or distal embolization. According to our results, STEMI post-PCI morbidity may not be affected by coronary artery dominance. However, patient demographics, comorbidities, lesion characteristics, and procedures may alter PCI outcomes. Our research expands on coronary artery dominance in STEMI treatment and focuses on risk assessment and targeted therapies for personalized patient care.

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Author Contributions

SJG: Manuscript writing for methodology design and investigation
AN: Validation of data, interpretation, and write-up of results
NA: Conception and design of the work
SFG: Data acquisition, curation, and statistical analysis
AB: Revising, editing, and supervising for intellectual content
FH: Writing the original draft, proofreading, and approval for final submission