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Original Article

Frequency Of Triple Vessel Coronary Artery Disease In Patients Admitted With Non-St-Elevation Myocardial Infarction Undergoing Coronary Angiography For First Time

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ABSTRACT

Objective: To determine the frequency of triple vessel coronary artery disease in non-ST-elevation myocardial infarction patients who were admitted for the first time to coronary angiography

Study Design: Cross-sectional study

Place and Duration of Study: Department of Cardiology, Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan from Jul 2018 to Jan 2019

Methodology: In this study, 140 participants enrolled by consecutive sampling technique underwent first-time coronary angiography under local anesthesia, performed by a Consultant Cardiologist with researcher assistance. The procedure used either femoral or radial artery access, and TVCAD was diagnosed if three cardiac vessels showed >50% stenosis.

Results: Out of one hundred and forty NSTEMI patients, the majority were males, 78(55.7%). A greater pool of patients, 58(41.4%), was 51-60 years old. Coronary angiography findings revealed that 43(30patients exhibited TVCAD, and 31(72.1%) were recommended for CABG. Additionally, seven patients (16.3%) were advised to undergo percutaneous coronary intervention (PCI), one patient (2.3%) for routine medical treatment, three patients (7.0%) for surgical review, and one patient (2.3%) for a viability scan. A significant association was found between the clinical decisions made and the presence of TVCAD ($p<0.001$).

Conclusion: A significant number of NSTEMI patients undergoing coronary angiography diagnosed with TVCAD emphasized the need for comprehensive coronary evaluation. Clinicians should consider enhanced screening and tailored treatments to manage this high-risk group effectively.

Keywords: Coronary angiography, non-ST-elevation myocardial infarction, percutaneous coronary intervention, coronary artery disease

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INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of death in developed countries, accounting for 17.9 million deaths annually, including 7.2 million from coronary artery disease (CAD).[1] Triple vessel disease (3VD) is the most severe form of CAD in acute coronary syndrome (ACS). Individuals of Indo-Asian descent, particularly in the Indo-Pak subcontinent, show higher susceptibility to CAD, contributing to elevated mortality rates.[2,3]

Multi-vessel coronary artery disease (MVD) poses substantial challenges to effective treatment, particularly in revascularization strategies aimed at restoring blood flow to the heart.[4] In some cases, percutaneous coronary intervention (PCI) successfully restores full blood flow, but where only partial revascularization is achieved, it can affect long-term health outcomes. Among the various forms of MVD, the most severe CAD (3VD) involves significant blockages in all three major coronary arteries, making it highly resistant to standard treatments. Thus, coronary artery bypass grafting (CABG) is preferred over PCI for managing 3VD due to its poor long-term prognosis if untreated or treated inadequately. The prevalence of 3VD in patients with non-ST elevation myocardial infarction (NSTEMI) is particularly concerning.[5,6]

Baumann *et al*., seven reported that 20.7% of NSTEMI cases involve 3VD, indicating its severity in ACS. NSTEMI shows higher post-discharge mortality than STEMI, especially in MVD cases. MVD is a significant cause of NSTEMI, highlighting the necessity for thorough evaluation and management.[7] These findings underscore the critical need for identifying and treating 3VD to enhance outcomes and lower future cardiac event risk.[8]

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Despite the rising incidence of NSTEMI compared to STEMI, there is surprisingly limited information on the prevalence of 3VD in NSTEMI patients. This lack of data is notable, especially when compared to the more extensive research available on STEMI and stable CAD cohorts.[9,10] Therefore, the current study focused on finding the frequency of 3VD in patients admitted with NSTEMI who underwent first-time coronary angiography.

METHODOLOGY

The study was conducted at the Department of Cardiology at Rawalpindi Institute of Cardiology, Rawalpindi, Pakistan after seeking ethical approval from IERB. The study period was 6 months, from July 2018 to January 2019, during which a sample of 140 patients with NTEMI and referred for coronary angiography was recruited as study participants. Sample size calculation was done using the WHO sample size calculator, keeping the 20.7% prevalence of TVCAD in NSTEMI patients.[7]

Inclusion Criteria: Patients of both genders with an age range of 21-70 years, admitted with NSTEMI, and underwent first-time coronary angiography were enrolled for research purposes.

Exclusion Criteria: Patients with a history of MI, previous PCI, previous coronary artery bypass graft (CABG) procedure, and valvular or congenital heart disease on medical records were excluded. Moreover, those NSTEMI patients with serum creatinine >1.7mg/dl and hemoglobin level <9 g/dl were also not recruited as study participants.

Before data collection, ethical approval was obtained from the institution, followed by informed consent from each study participant recruited via a non-probability consecutive sampling technique from cardiology wards of the hospital. Demographics were noted from patients' history forms on pre-designed data collection proforma. These patients underwent successful angiography under local anesthesia. The Consultant Cardiologist performed coronary angiography, and the researcher assisted him. Either femoral or radial artery access was used for the procedure. Consultants reported the coronary lesions. If three cardiac vessels had >50% stenosis, then TVCAD was labeled. Statistical Software, the Statistical Package for Social Sciences (SPSS) version 23:00, was utilized for data entry and analysis. Descriptive statistics (frequency/percentage, mean/standard deviation) were run for categorical and continuous data. The chi-square test was applied to find the gender-based, age-based, and clinical decisions-based differences in the TVCAD frequency, and the significance level was set at $p \leq 0.05$.

RESULTS

In the given study's sample of one hundred and forty, the majority of NSTEMI patients presented during the study period were males, 78(55.7%). A greater pool of patients, 58(41.4%), belonged to the age group of 51-60 years, and only 4(2.9%) patients had an age range of 21-30 years. Coronary angiography findings revealed that the majority of the patients, 43(30.7%), exhibited TVCAD, followed by SVCAD and minimal CAD (23.6% and 22.9%, respectively). Two patients had normal coronaries despite NSTEMI (Table-I).

Table-I: Frequency distribution of Demographics and Diagnosis of Study Sample (n=140)

Variables	Frequency (%)
Gender	
Male	78 (55.7%)
Female	62 (44.3%)
Age (years)	
21-30	4 (2.9%)
31-40	20 (14.3%)
41-50	28 (20.0%)
51-60	58 (41.4%)
61-70	30 (21.4%)
Diagnosis	
SVCAD	33 (23.6%)
DVCAD	29 (20.7%)
TVCAD	43 (30.7%)
Minimal CAD	32 (22.9%)
Ectatic Coronaries	1 (0.7%)
Normal coronaries	2 (1.4%)

CAD= Coronary Artery Disease; SVCAD=Single Vessel CAD; DVCAD=Double Vessel CAD; TVCAD=Triple Vessel CAD

Similarly, the Figure-1 predicted a 30.7% prevalence of TVCAD in patients of NSTEMI who underwent coronary angiography, while only 1.4% of patients had normal coronaries. Based on patients' clinical conditions and coronary angiography findings, a large pool of patients was referred for coronary artery bypass grafting (CABG) procedure 42 (30.0%). Thirty-nine patients (27.9%) were suggested for medical treatment, and multi-vessel PCI was suggested in 7 (16.3%) patients (Figure-2).

Table-II reveals that more males than females had TVCAD, though this gender difference was not statistically significant ($p>0.05$). TVCAD was most commonly observed in the 51-60 years age group, where 21 individuals (48.8%) were affected; however, the association between age and the presence of

TVCAD was also not significant (p>0.05). Regarding clinical management, most NSTEMI patients with TVCAD were recommended for CABG 31 (72.1%). Additionally, seven patients (16.3%) were advised to undergo PCI, one patient (2.3%) for routine medical treatment, three patients (7.0%) for surgical review, and one patient (2.3%) for a viability scan. A significant association was found between the clinical decisions made and the presence of TVCAD (p<0.001).

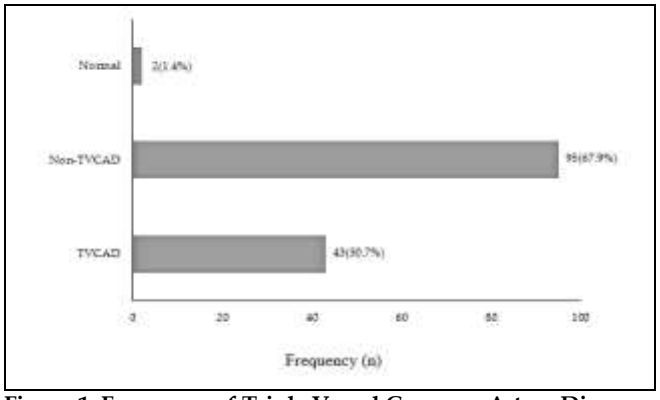

Figure-1: Frequency of Triple Vessel Coronary Artery Disease in NSTEMI Patients (n=140)

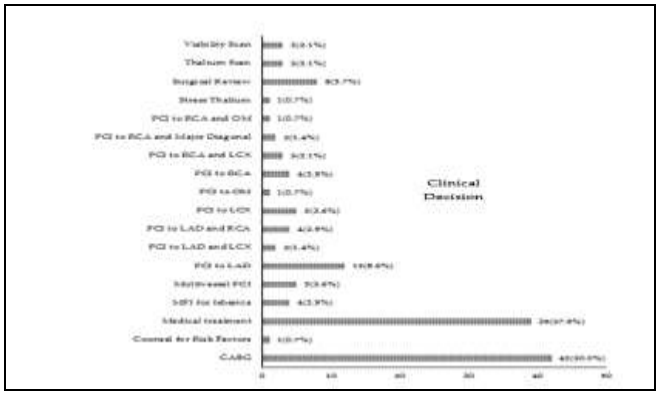

Figure-2: Frequency distribution of Clinical Decisions (n=140)
LAD=Left Anterior Descending; RCA=Right Coronary Artery; LCX=Left Circumflex; OM=Obtuse Marginal; PCI=Percutaneous Coronary Intervention; MPI=Myocardial Perfusion Imaging; CABG=Coronary Artery Bypass Grafting

DISCUSSION

In our study, coronary angiography findings revealed that 30.7% of NSTEMI patients had triple vessel coronary artery disease (TVCAD), while a small percentage had normal coronaries (1.4%). Most patients with TVCAD were recommended for coronary artery bypass grafting (CABG) (72.1%), with others advised for percutaneous coronary intervention (PCI) (16.3%) or medical treatment. Although TVCAD was more common in males and the 51-60 age group, these differences were not statistically significant. However, a significant association existed between TVCAD and the clinical management decisions made (p<0.001).

Table-II: Association of Gender, Age and clinical Decision with Triple Vessel Coronary Artery Disease (n=140)

Variables		TVCAD Frequency (%)		*p*-value
		Yes Total=43	No Total=97	
Gender	Male	29(67.4%)	49(50.5%)	0.094
	Female	14(32.6%)	48(49.5%)	
Age (years)	21-30	0(0.0%)	4(4.1%)	0.504
	31-40	5(11.6%)	15(15.5%)	
	41-50	7(16.3%)	21(21.6%)	
	51-60	21(48.8%)	37(38.1%)	
	61-70	10(23.3%)	20(20.6%)	
Clinical Decision	CABG	31(72.1%)	11(11.3%)	<0.001
	Multi-vessel PCI	5(11.6%)	0(0.0%)	
	PCI to LAD	1(2.3%)	11(11.3%)	
	PCI to RCA	0(0.0%)	4(4.1%)	
	PCI to LCX	0(0.0%)	5(5.2%)	
	PCI to OM	0(0.0%)	1(1.0%)	
	PCI to LAD and RCA	0(0.0%)	4(4.1%)	
	PCI to LAD and LCX	1(2.3%)	1(1.0%)	
	PCI to RCA and LCX	0(0.0%)	3(3.1%)	
	PCI to RCA and OM	0(0.0%)	1(1.0%)	
	PCI to RCA and Major Diagonal	0(0.0%)	2(2.1%)	
	Medical treatment	1(2.3%)	38(39.2%)	
	Surgical Review	3(7.0%)	5(5.2%)	
	Counsel for Risk Factors	0(0.0%)	1(1.0%)	
	MPI for Ischemia	0(0.0%)	4(4.1%)	
	Stress Thallium	0(0.0%)	1(1.0%)	
	Thallium Scan	0(0.0%)	3(3.1%)	
	Viability Scan	1(2.3%)	2(2.1%)	

CABG=Coronary Artery Bypass Graft; PCI=Percutaneous Coronary Intervention; LAD=Left Anterior Descending Artery; RCA=Right Coronary Artery; OM=Obtuse Marginal; LCX=Left Circumflex; TVCAD=Triple Vessel Coronary Artery Disease

A past study by Carvalho *et al.*, in Portugal reported the prevalence of MVD as 18%, lower than found in our study.[11] However, consistent with the current study's findings, some other studies reported

40-60% prevalence in non-consecutive NSTEMI patients who were recommended for treatment by PCI.[12–14] Adil *et al*., documented 27.50% cases of TVCAD out of 800 study subjects align with the prevalence observed in our study 30.7%.[15] Another study done by Ahmed and his coworkers in the National Institute of Cardiovascular Diseases (NICVD), Karachi, enrolled 250 NSTEMI patients revealed a significantly higher prevalence of TVCAD (42.8%), and it was more frequent in males than females (77.6% vs. 22.4%).[2]

According to the study by Ahmed *et al*., on a Pakistani cohort of 139 patients, most NSTEMI cases were males (70.5%). They aged≥40 years, and 3VD was diagnosed in 30.2% of patients.16 Salman *et al*., in their study conducted at Hayatabad Medical Complex, Peshawar, reported 39.7% cases of NSTEMI with coronary lesions in three vessels.[17] Consistent with these, similar findings of another study, sampled NSTEMI patients with 3VD, greater frequency of males 76.1% have been noted in a study with a mean age of 66.3±12.4 years.7 Similar to this, our study reported 67.4% males with TVCAD, while the majority of the TVCAD sample belonged to the age group 51-60 years, 23.3% belonged to the age group 61-70 years, and 3VDprevalence was 30.7%. The discrepancy in mean age might be due to the sample size difference, as the cited study comprised 3722 NSTEMI patients. However, these findings underscore the importance of comprehensive coronary evaluations in older male populations with NSTEMI, especially in Pakistani settings, to improve outcomes and optimize treatment pathways.

Thus, high prevalence underscores the complexity and severity of coronary artery involvement in NSTEMI cases, where multiple coronary vessels are affected by significant blockages. The presence of MVD in such a large proportion of NSTEMI patients highlights the need for comprehensive diagnostic evaluations and tailored treatment strategies to manage these high-risk individuals and improve their long-term outcomes effectively.[18] Moreover, such patients with NSTEMI also tend to experience worse clinical outcomes compared to those with disease in only one coronary artery. The presence of MVD adds complexity to their condition, making their prognosis less favorable.[19,20] In managing NSTEMI, percutaneous coronary intervention (PCI) has become the most common revascularization approach to restore blood flow and improve survival rates. However, the added challenge of MVD necessitates careful consideration during treatment to optimize patient outcomes.[21]

A retrospective analysis of the contemporary registry study, the Coronary Angiogram Database of South Australia (CADOSA), was conducted by Baumann and colleagues. They examined NSTEMI patients who underwent coronary angiography between 2012 and 2016 and revealed that 20.7% of these patients were diagnosed with TVCAD. Despite the severity of TVCAD, only 22% of these patients underwent percutaneous coronary intervention (PCI), while a significant majority, 66%, were referred for coronary artery bypass grafting (CABG).[7] Comparatively, our study demonstrated that 72.1% of patients were recommended for CABG procedure and 16.3% for PCI. This can be signified by the conclusion given by Khan et al., who found superior post-operative outcomes in CABG cases compared to PCI cases for managing TVCAD in Pakistani patients, particularly in reducing the risk of recurrent myocardial infarctions and the need for repeat revascularization. These long-term benefits support that CABG should be prioritized in cases where patients present with extensive or severe coronary artery blockages, offering better prognoses and durability.[22]

The decision-making process involves weighing the benefits and risks of various interventions, such as PCI versus CABG.[23] Given the complexity of conditions like TVCAD, where multiple arteries are blocked, clinicians must carefully evaluate the most effective treatment options.[22-24] Thus, the study's findings emphasize the need to identify the severity of CAD and create personalized treatment plans that consider the unique characteristics of each patient's condition, aiming to optimize their prognosis and quality of life.

LIMITATIONS OF STUDY

The given study is limited by its small sample size and focused only on patients admitted for coronary angiography, which may not represent all patients with NSTEMI. This could limit the generalizability of the findings to the broader population of NSTEMI patients. Patients' comorbid conditions and medications have not been studied. Future studies with more extensive, multicenter cohorts and extended follow-up periods should include short-term, intermediate-term, and long-term outcomes of TVCAD SVCAD and DVCAD patients for timely and effective intervention and have deep insights into optimizing patient care.

CONCLUSION

The current study was an insight step into the prevalence of TVCAD in NSTEMI patients who were admitted for coronary angiography. Study findings indicate that a significant proportion of the study sample is diagnosed with TVCAD, which highlights the substantial burden of multi-vessel CAD and underscores the importance of thorough coronary evaluation in NSTEMI cases. Clinicians should be vigilant for the presence of extensive coronary artery disease when managing NSTEMI patients, as TVCAD may impact treatment decisions and prognostic assessments. Enhanced screening and tailored therapeutic strategies might be necessary to address the needs of this high-risk group effectively.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

RA & MKI: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

NA & MMA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MA & RI: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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