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Frequency and Predictors of Triple Vessel Coronary Artery Disease Among Patients Presenting with Non-ST-Segment Elevation Myocardial Infarction: A Cross-Sectional Study at a Tertiary Care Cardiac Center.

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Abstract

Background: To determine the frequency of triple vessel coronary artery disease (TVCAD) among patients presenting with non-ST-segment elevation myocardial infarction (NSTEMI) and to identify demographic and clinical factors associated with its occurrence.

Methodology: This analytical cross-sectional study was conducted in the Department of Cardiology, Hayatabad Medical Complex, Peshawar. A total of 166 patients aged 20–80 years diagnosed with NSTEMI were consecutively enrolled. All participants underwent coronary angiography to evaluate the extent of coronary artery involvement. TVCAD was defined as ≥70% stenosis in all three major epicardial coronary arteries, namely the left anterior descending (LAD), left circumflex (LCX), and right coronary artery (RCA). Demographic characteristics, cardiovascular risk factors, and angiographic findings were recorded using a structured proforma.

Results: The mean age of the participants was 56.69 ± 13.79 years, and the mean body mass index was 28.32 ± 2.86 kg/m². Males constituted 65.1% of the study population, while 54.2% were residents of rural areas. Triple vessel coronary artery disease was identified in 58 patients, corresponding to a frequency of 34.9%. Univariate analysis demonstrated significant associations between TVCAD and male gender (46.3% vs. 13.8%, p<0.001), rural residence (46.7% vs. 21.1%, p<0.001), low socioeconomic status (p<0.001), and smoking (60.0% vs. 25.6%, p<0.001). Following multivariable adjustment, male gender (adjusted odds ratio [aOR] 4.82; 95% CI: 2.10–11.05; p<0.001) and smoking (aOR 4.15; 95% CI: 1.98–8.69; p<0.001) remained independent predictors of TVCAD. No significant associations were observed with age, body mass index, hypertension, diabetes mellitus, dyslipidemia, or chronic kidney disease.

Conclusion: Approximately one-third of patients presenting with NSTEMI had angiographically confirmed triple vessel coronary artery disease. Male gender and smoking emerged as independent predictors of extensive coronary involvement.

Keywords

Non-ST-Segment Elevation Myocardial Infarction, Triple Vessel Coronary Artery Disease, Coronary Angiography, Acute Coronary Syndrome, Smoking, Risk Factors.

Introduction

Acute coronary syndrome (ACS) remains one of the leading causes of morbidity and mortality worldwide, accounting for a substantial proportion of cardiovascular-related hospital admissions and deaths. Non-ST-segment elevation myocardial infarction (NSTEMI) represents a common and clinically significant form of ACS characterized by myocardial ischemia and necrosis occurring in the absence of persistent ST-segment elevation on electrocardiography[1]. Patients with NSTEMI frequently present with chest pain, dyspnea, diaphoresis, nausea, epigastric discomfort, or atypical symptoms, particularly among elderly individuals, women, and patients with diabetes mellitus[2]. The condition is commonly associated with established cardiovascular risk factors, including hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and advancing age[3].

The underlying pathophysiology of NSTEMI is most often related to disruption of an atherosclerotic plaque, followed by platelet aggregation and partial thrombotic occlusion of a coronary artery, resulting in myocardial ischemia and cellular injury[4]. Although the degree of coronary obstruction may vary, a considerable proportion of NSTEMI patients exhibit extensive coronary artery disease involving multiple vascular territories. The severity and extent of coronary artery involvement play a crucial role in determining prognosis, treatment strategy, and long-term clinical outcomes.

Triple vessel coronary artery disease (TVCAD) represents one of the most severe manifestations of atherosclerotic coronary disease and is characterized by significant stenosis involving the three major epicardial coronary arteries: the left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA)[5]. Patients with TVCAD typically have a greater burden of atherosclerosis, more extensive myocardial ischemia, and an increased risk of adverse cardiovascular events compared with those having single- or double-vessel disease[6]. Coronary angiography remains the gold standard for evaluating coronary anatomy and determining the extent of vessel involvement, thereby guiding decisions regarding medical therapy, percutaneous coronary intervention, or coronary artery bypass grafting[7].

The presence of TVCAD among patients with NSTEMI has important clinical implications. Several studies have demonstrated that multivessel coronary artery disease is associated with higher rates of recurrent ischemic events, heart failure, repeat hospitalization, and mortality[8,9]. Furthermore, the identification of extensive coronary involvement may significantly influence the choice and timing of revascularization strategies. Patients with TVCAD often require more aggressive management approaches and closer long-term follow-up because of their elevated cardiovascular risk profile[10].

Previous studies have reported varying frequencies of TVCAD among NSTEMI patients, ranging from approximately 20% to over 50%, reflecting differences in patient characteristics, risk factor profiles, referral patterns, and healthcare settings[11]. Several demographic and clinical factors, including male gender, smoking, diabetes mellitus, and socioeconomic disparities, have also been investigated as potential determinants of extensive coronary artery disease[12]. However, findings have not been entirely consistent across populations, emphasizing the need for context-specific evidence.
In Pakistan, cardiovascular disease constitutes a major public health challenge, with a growing prevalence of diabetes mellitus, hypertension, tobacco use, obesity, and dyslipidemia. Despite this increasing burden, limited local data are available regarding the frequency and predictors of TVCAD among patients presenting with NSTEMI, particularly in the northwestern region of the country. Understanding the angiographic profile of NSTEMI patients in this population may assist clinicians in identifying individuals at higher risk of severe coronary disease and optimizing management strategies accordingly.

Therefore, the present study was conducted to determine the frequency of triple vessel coronary artery disease among patients presenting with NSTEMI at a tertiary care cardiac center and to evaluate demographic and clinical factors associated with its occurrence.

Methodology

Study Design

This analytical cross-sectional study was conducted to determine the frequency of triple vessel coronary artery disease (TVCAD) among patients presenting with non-ST-segment elevation myocardial infarction (NSTEMI) and to identify demographic and clinical factors associated with TVCAD. The study employed a hospital-based observational design in which eligible patients were consecutively enrolled and evaluated using standardized clinical, laboratory, and angiographic procedures. The study was conducted over a six-month period from 01 August 2025 to 01 February 2026.

Ethics

Prior to commencement, ethical approval was obtained from the Institutional Research Board of Hayatabad Medical Complex (HMC), Peshawar (Approval No. 2069 dated 04.09.2024). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment. For patients who were unable to provide consent at presentation, consent was obtained from legally authorized representatives. Participants were informed about the objectives of the study, the voluntary nature of participation, confidentiality of data, and their right to withdraw from the study at any stage without affecting their medical care. All collected information was anonymized before statistical analysis to ensure privacy and confidentiality.

Setting

The study was carried out in the Department of Cardiology, Hayatabad Medical Complex, Peshawar, a tertiary care teaching hospital that receives referrals from both urban and rural areas of Khyber Pakhtunkhwa and neighboring regions. The institution provides round-the-clock emergency cardiac services, including invasive coronary angiography and management of acute coronary syndromes. Eligible patients presenting to the emergency department, coronary care unit, or cardiology wards with a diagnosis of NSTEMI were screened for inclusion during the study period.

Participants

Patients aged 20–80 years of either gender who fulfilled the diagnostic criteria for NSTEMI and subsequently underwent coronary angiography were considered eligible. Consecutive sampling was employed to minimize selection bias and ensure representation of all eligible cases presenting during the study period.

NSTEMI was diagnosed according to the Fourth Universal Definition of Myocardial Infarction. Diagnosis required the presence of symptoms suggestive of myocardial ischemia, including chest pain or anginal equivalents such as dyspnea, diaphoresis, nausea, epigastric discomfort, or unexplained fatigue, together with elevated cardiac troponin levels and electrocardiographic changes consistent with NSTEMI. Patients with atypical clinical presentations, particularly elderly individuals, females, and patients with diabetes mellitus, were also evaluated according to the same diagnostic criteria.

Patients with unstable angina, ST-segment elevation myocardial infarction, cardiogenic shock, previous coronary artery bypass graft surgery, prior coronary stenting, congenital heart disease, myocarditis, pregnancy, or coronary stenosis secondary to stimulant use were excluded. These exclusion criteria were applied to reduce clinical heterogeneity and minimize confounding factors that could influence angiographic findings.

Variables

The primary outcome variable was the presence or absence of triple vessel coronary artery disease. TVCAD was defined as angiographically confirmed luminal stenosis of ≥70% involving all three major epicardial coronary artery territories: left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA), consistent with contemporary cardiology guidelines. Independent variables included age, gender, residence (urban/rural), socioeconomic status, smoking status, body mass index (BMI), hypertension, diabetes mellitus, dyslipidemia, and chronic kidney disease. Socioeconomic status was categorized as low, middle, or high according to self-reported household

income and occupation. Smoking status was classified as current smoker or non-smoker at the time of admission.

Data Sources / Measurement

Data were collected using a structured proforma designed specifically for the study. Baseline demographic information and clinical history were obtained through direct patient interviews and review of hospital medical records. Anthropometric measurements, including height and weight, were recorded using calibrated instruments, and body mass index was calculated as weight in kilograms divided by height in meters squared (kg/m²).

Blood samples were obtained as part of routine clinical management. Cardiac troponin I levels were measured using the hospital laboratory's standardized immunoassay system. A troponin value above the 99th percentile upper reference limit with a dynamic rise or fall pattern was considered diagnostic of myocardial injury. Electrocardiograms were performed and interpreted by cardiologists according to standard clinical practice.

Coronary angiography was performed in all enrolled patients using standard femoral or radial arterial access techniques. Contrast-enhanced fluoroscopic imaging was used to visualize coronary anatomy and quantify the degree of luminal stenosis. Angiograms were independently reviewed by an interventional cardiologist with at least two years of experience who was blinded to the study objectives and participant demographic characteristics. The percentage stenosis in the LAD, LCX, and RCA was recorded. Lesions in branch vessels such as obtuse marginal and diagonal arteries were attributed to their parent vessels and were not considered separate criteria for defining TVCAD.

Bias

Several measures were implemented to minimize potential sources of bias. Consecutive enrollment of eligible patients was performed to reduce selection bias. Standardized diagnostic criteria for NSTEMI and predefined angiographic criteria for TVCAD were used to limit classification bias. Data collection was conducted using a structured proforma to ensure consistency across participants. Angiographic assessments were performed by an experienced interventional cardiologist who was blinded to patient demographic and clinical characteristics, thereby reducing observer bias. Prior to statistical analysis, all data were checked for completeness, accuracy, and coding consistency. Any discrepancies identified during data verification were resolved through review of original patient records and angiographic reports.

Study Size

The sample size was calculated using the World Health Organization sample size calculator based on an anticipated prevalence of TVCAD among NSTEMI patients of 30.2%, as reported by Ahmed et al. [11]. Assuming a 95% confidence level and a margin of error of 7%, the minimum required sample size was estimated to be 166 participants. The calculated sample size was achieved during the study period, and all eligible participants meeting inclusion criteria were included in the final analysis.

Quantitative Variables

Age, height, weight, and body mass index were treated as continuous quantitative variables and summarized using means and standard deviations. For stratified analyses, age was categorized into ≤50 years and >50 years, while BMI was categorized into ≤25 kg/m² and >25 kg/m². Troponin concentrations and angiographic stenosis percentages were measured as continuous variables during clinical assessment; however, angiographic findings were subsequently categorized according to the predefined TVCAD criteria. Categorical variables such as gender, residence, smoking status, socioeconomic status, hypertension, diabetes mellitus, dyslipidemia, chronic kidney disease, and TVCAD status were summarized using frequencies and percentages.

Statistical Methods

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Data cleaning and validation procedures were performed before analysis to identify missing values, inconsistencies, and data-entry errors. Descriptive statistics were generated for all study variables. Continuous variables were presented as mean ±

standard deviation, whereas categorical variables were reported as frequencies and percentages.

Univariate analysis was performed to assess associations between participant characteristics and TVCAD status. The chi-square test was applied when assumptions for expected cell frequencies were met, while Fisher's exact test was used when appropriate. Stratified analyses were conducted according to age, gender, residence, socioeconomic status, BMI, smoking status, hypertension, diabetes mellitus, dyslipidemia, and chronic kidney disease.

Variables demonstrating a significance level of $p<0.20$ in univariate analysis were entered into a multivariable logistic regression model using the Enter method to identify independent predictors of TVCAD while controlling for potential confounding. Adjusted odds ratios (aORs) and corresponding 95% confidence intervals (CIs) were calculated. Model calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test, with a p-value greater than 0.05 indicating satisfactory model fit. All statistical tests were two-tailed, and a p-value ≤0.05 was considered statistically significant.

Results

Participants

A total of 166 patients diagnosed with non-ST-segment elevation myocardial infarction (NSTEMI) were screened and enrolled during the study period. All participants fulfilled the predefined eligibility criteria and underwent coronary angiography. Complete demographic, clinical, laboratory, and angiographic data were available for all enrolled patients; therefore, no participants were excluded from the final analysis. The final study population comprised 166 NSTEMI patients who were included in the assessment of the frequency of triple vessel coronary artery disease (TVCAD) and its associated factors.

Descriptive Data

The baseline demographic and clinical characteristics of the study population are presented in Table I. The mean age of the participants was 56.69 ± 13.79 years, indicating that the majority of patients were middle-aged to elderly. The mean height, weight, and body mass index (BMI) were 165.61 ± 7.74 cm, 77.84 ± 10.75 kg, and 28.32 ± 2.86 kg/m², respectively.

Male patients constituted the majority of the study population (108, 65.1%), while females accounted for 58 (34.9%) participants. Regarding place of residence, 90 (54.2%) patients belonged to rural areas and 76 (45.8%) resided in urban settings. Socioeconomic assessment revealed that both low-income and middle-income groups comprised 69 (41.6%) participants each, whereas only 28 (16.9%) belonged to the high-income category. Smoking was reported by 45 (27.1%) patients.

Among cardiovascular comorbidities, hypertension was the most frequently reported condition, affecting 85 (51.2%) patients, followed by dyslipidemia in 79 (47.6%) patients and diabetes mellitus in 75 (45.2%) patients. Chronic kidney disease was present in 17 (10.2%) participants. These findings demonstrate a substantial burden of conventional cardiovascular risk factors among NSTEMI patients included in the study (Table 1).

Outcome Data

The primary outcome of interest was the presence of triple vessel coronary artery disease (TVCAD) on coronary angiography. As shown in Table II, TVCAD was identified in 58 out of 166 patients, resulting in an overall frequency of 34.9% (95% CI approximately 27.7%–42.1%). Conversely, 108 (65.1%) patients did not demonstrate triple vessel involvement.

Analysis of angiographic findings revealed that the left anterior descending artery (LAD) was the most frequently affected epicardial coronary vessel, being involved in 108 (65.1%) patients. The right coronary artery (RCA) was involved in 88 (53.0%) patients, whereas the left circumflex artery (LCX) showed significant stenosis in 83 (50.0%) patients.

Since multiple vessels could be involved in the same patient, the frequencies of individual vessel involvement exceeded the frequency of TVCAD. Detailed angiographic findings are presented in Table 2.

Main results

The relationship between CAC distribution and The association between demographic and clinical variables and TVCAD is summarized in Table III. Stratified analysis demonstrated that age was not significantly associated with TVCAD. Patients aged ≤50 years had a TVCAD frequency of 38.3% compared with 33.0% among those aged >50 years (p=0.490). Similarly, no statistically significant association was observed between BMI category and TVCAD prevalence (38.1% vs. 34.5%; p=0.746).

Gender showed a strong and statistically significant association with TVCAD. Nearly half of all male patients (50/108, 46.3%) had TVCAD, compared with only 8 of 58 female patients (13.8%) (p<0.001). Likewise, place of residence was significantly associated with disease severity, as TVCAD was observed in 42 of 90 rural residents (46.7%) compared with 16 of 76 urban residents (21.1%) (p<0.001).

A significant relationship was also observed between socioeconomic status and TVCAD. The highest frequency of TVCAD was found among low-income participants (52.2%), followed by middle-income (24.6%) and high-income groups (17.9%), demonstrating a significant socioeconomic gradient (p<0.001). Smoking status showed one of the strongest associations with TVCAD, with 60.0% of smokers exhibiting TVCAD compared with only 25.6% of non-smokers (p<0.001).

No statistically significant associations were identified between TVCAD and hypertension (p=0.228), diabetes mellitus (p=0.694), dyslipidemia (p=0.897), or chronic kidney disease (p=0.569), although these conditions were highly prevalent within the study population (Table 3).

To identify independent predictors of TVCAD, variables demonstrating potential association in univariate analysis (p<0.20) were entered into a multivariable logistic regression model. The findings are presented in Table IV. After adjustment for potential confounding variables, male gender remained a significant independent predictor of TVCAD, increasing the odds of triple vessel disease by approximately fivefold (adjusted odds ratio [aOR] = 4.82, 95% CI: 2.10–11.05, p<0.001).

Smoking also remained independently associated with TVCAD, with smokers having more than four times higher odds of disease compared with non-smokers (aOR = 4.15, 95% CI: 1.98–8.69, p<0.001).

Although rural residence and low socioeconomic status showed significant associations in univariate analysis, these associations did not remain statistically significant after adjustment for other covariates (rural residence: aOR = 2.10, p=0.057; low socioeconomic status: aOR = 2.45, p=0.096). The final regression model demonstrated satisfactory calibration according to the Hosmer–Lemeshow goodness-of-fit test (χ^2 = 6.32, df = 8, p = 0.612), indicating an acceptable fit between observed and predicted outcomes (Table 4).

The results indicate that approximately one-third of NSTEMI patients had angiographically confirmed TVCAD. Male gender and smoking emerged as the strongest independent predictors of extensive coronary artery involvement, whereas age, BMI, hypertension, diabetes mellitus, dyslipidemia, and chronic kidney disease were not significantly associated with TVCAD in this study population.

Table 1: Patient demographics (N=166).

Demographics	Mean ± SD / n (%)
Age (years)	56.69 ± 13.79
Height (cm)	165.61 ± 7.74
Weight (kg)	77.84 ± 10.75
BMI (kg/m²)	28.32 ± 2.86
Gender	
Male	108 (65.1%)

Female	58 (34.9%)
Residence	
Rural	90 (54.2%)
Urban	76 (45.8%)
Socioeconomic status	
Low	69 (41.6%)
Middle	69 (41.6%)
High	28 (16.9%)
Smoking	45 (27.1%)
Comorbidities	
Hypertension	85 (51.2%)
Diabetes mellitus	75 (45.2%)
Dyslipidemia	79 (47.6%)
Chronic kidney disease	17 (10.2%)

Table 2: Frequency of TVCAD and involvement of major epicardial vessels (N=166).

Variables	Frequency	Percentage (%)
Triple vessel coronary artery disease (TVCAD)		
Yes	58	34.9
No	108	65.1
Major epicardial vessel involvement		
Left anterior descending (LAD)	108	65.1
Right coronary (RCA)	88	53.0
Left circumflex (LCX)	83	50.0

A single patient may have more than one vessel involved. Branch vessel stenoses (obtuse marginal, diagonal) were attributed to the parent artery.

Table 3: Univariate association of demographic and clinical factors with TVCAD (N=166).

Demographic Factors	Subgroup	Total N	TVCAD Yes n(%)	TVCAD No n(%)	p-value
Age (years)	≤50	60	23 (38.3%)	37 (61.7%)	0.490
	>50	106	35 (33.0%)	71 (67.0%)	
Gender	Male	108	50 (46.3%)	58 (53.7%)	<0.001*
	Female	58	8 (13.8%)	50 (86.2%)	
Residence	Rural	90	42 (46.7%)	48 (53.3%)	<0.001*
	Urban	76	16 (21.1%)	60 (78.9%)	
Socioeconomic status	Low	69	36 (52.2%)	33 (47.8%)	<0.001*
	Middle	69	17 (24.6%)	52 (75.4%)	
	High	28	5 (17.9%)	23 (82.1%)	
BMI (kg/m²)	≤25	21	8 (38.1%)	13 (61.9%)	0.746
	>25	145	50 (34.5%)	95 (65.5%)	
Smoking	Yes	45	27 (60.0%)	18 (40.0%)	<0.001*
	No	121	31 (25.6%)	90 (74.4%)	
Hypertension	Yes	85	26 (30.6%)	59 (69.4%)	0.228
	No	81	32 (39.5%)	49 (60.5%)	

Diabetes mellitus	Yes	75	25 (33.3%)	50 (66.7%)	0.694
	No	91	33 (36.3%)	58 (63.7%)	
Dyslipidemia	Yes	79	28 (35.4%)	51 (64.6%)	0.897
	No	87	30 (34.5%)	57 (65.5%)	
Chronic kidney disease	Yes	17	7 (41.2%)	10 (58.8%)	0.569
	No	149	51 (34.2%)	98 (65.8%)	

*p<0.05 is considered significant.

A single patient may have more than one vessel involved. Branch vessel stenoses (obtuse marginal, diagonal) were attributed to the parent artery.

Table 4: Multivariable logistic regression – independent predictors of TVCAD.

Variables	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Male gender	4.82	2.10 – 11.05	<0.001*
Smoking (yes)	4.15	1.98 – 8.69	<0.001*
Rural residence	2.10	0.98 – 4.50	0.057
Low SES (vs high)	2.45	0.85 – 7.05	0.096
Middle SES (vs high)	1.45	0.48 – 4.38	0.512

*p<0.05 is considered significant.

Hosmer-Lemeshow test: $\chi^2 = 6.32$, df = 8, p = 0.612

Discussion

The present study evaluated the frequency of triple vessel coronary artery disease (TVCAD) among patients presenting with non-ST-segment elevation myocardial infarction (NSTEMI) and examined demographic and clinical factors associated with its occurrence. The findings demonstrated that TVCAD was present in 34.9% of NSTEMI patients, indicating that approximately one in every three patients had extensive involvement of all three major epicardial coronary arteries. This observation underscores the substantial burden of advanced coronary artery disease among patients presenting with NSTEMI and highlights the importance of early angiographic assessment for risk stratification and treatment planning.

The frequency of TVCAD observed in this study is broadly consistent with previous regional and international reports. Ahmed et al. reported a prevalence of 30.2% among NSTEMI patients[11], while Ahmed et al. documented a frequency of approximately 30% in a similar clinical population[12]. The similarity of these findings suggests that severe multivessel coronary disease is relatively common among NSTEMI patients across different healthcare settings. However, the prevalence observed in the current study was higher than that reported by Yousaf et al. (21.4%)[13] and Zahoor et al. (16.9%)[14]. Such variations may be attributable to differences in patient demographics, prevalence of cardiovascular risk factors, referral patterns, angiographic criteria, and healthcare accessibility. Conversely, studies by Ahmed et al.[15] and Rathi et al.[16] reported higher frequencies of TVCAD, which may reflect the inclusion of populations with greater cardiovascular risk burdens, such as diabetic patients or individuals referred to specialized tertiary cardiac centers.

Gender emerged as one of the strongest factors associated with TVCAD in the present study. Male patients demonstrated a significantly higher frequency of TVCAD than female patients, and this association remained statistically significant after adjustment for other variables. Similar findings have been reported by Rasool et al., who observed a significant relationship between male gender and extensive coronary artery disease among NSTEMI patients with diabetes mellitus[17]. Several biological and behavioral explanations have been proposed in the literature. Men generally develop clinically

significant coronary artery disease at an earlier age than women and often exhibit a higher prevalence of traditional cardiovascular risk factors. Furthermore, the cardioprotective effects of endogenous estrogen during the premenopausal period may contribute to delayed progression of atherosclerosis among women. Nevertheless, because of the cross-sectional design of the present study, no causal inferences can be drawn regarding the relationship between gender and TVCAD. The findings should therefore be interpreted as an observed association rather than evidence of a direct causal effect.

Smoking was another important factor associated with TVCAD. Smokers exhibited a markedly higher prevalence of triple vessel disease compared with non-smokers, and smoking remained an independent predictor after multivariable adjustment. These findings are consistent with previous reports demonstrating a strong relationship between tobacco use and severe coronary artery disease[17-19]. Experimental and epidemiological studies have shown that cigarette smoking promotes endothelial dysfunction, oxidative stress, inflammation, platelet activation, and accelerated atherosclerotic plaque formation, all of which contribute to the progression of coronary artery disease. Although the present study cannot establish causality, the persistence of this association after adjustment for potential confounders supports the clinical importance of smoking as a major modifiable cardiovascular risk factor. These findings further reinforce the need for comprehensive smoking cessation interventions as part of secondary prevention strategies in patients presenting with acute coronary syndromes.

Residence and socioeconomic status demonstrated significant associations with TVCAD in univariate analyses but lost statistical significance after multivariable adjustment. This finding suggests that the apparent relationship between these variables and TVCAD may be partially explained by other interrelated factors, including differences in smoking prevalence, healthcare access, health literacy, and cardiovascular risk profiles. Although these variables were not independent predictors in the final model, the observed trends warrant further investigation because social determinants of health continue to play an important role in cardiovascular disease outcomes worldwide.

Interestingly, no significant associations were observed between TVCAD and age, body mass index, hypertension, diabetes mellitus, dyslipidemia, or chronic kidney disease. These findings differ from those of several previous studies that have identified these factors as important contributors to advanced coronary artery disease[3,15,17]. One possible explanation is that these comorbid conditions were highly prevalent throughout the study population, thereby reducing the ability to detect statistically significant differences between patients with and without TVCAD. Additionally, the relatively modest sample size may have limited the statistical power required to identify weaker associations. It is also possible that the influence of these variables may become more evident in larger multicenter cohorts with broader demographic diversity.

The findings of the present study have important clinical implications. Given that more than one-third of NSTEMI patients had angiographically confirmed TVCAD, clinicians should maintain a high index of suspicion for extensive coronary involvement, particularly among male patients and smokers. Early recognition of patients at increased risk for severe multivessel disease may facilitate prompt invasive evaluation, informed decision-making regarding revascularization strategies, and implementation of aggressive risk-factor modification programs. Such approaches have the potential to improve long-term cardiovascular outcomes and reduce recurrent ischemic events.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design allows assessment of associations but does not permit determination of temporal relationships or causal inferences between risk factors and TVCAD. Second, the study was conducted at a single tertiary care center, which may introduce referral bias and limit the generalizability of the findings to other healthcare settings or populations. Third, although consecutive sampling was employed,

selection bias cannot be completely excluded because only patients who underwent coronary angiography were included. Patients managed conservatively or those with contraindications to angiography were not represented. Fourth, the sample size, while adequate for estimation of frequency, may have limited the ability to detect smaller associations and may have reduced the precision of subgroup analyses. Fifth, despite multivariable adjustment, residual confounding remains possible. Several potentially important variables, including duration and intensity of smoking, family history of premature coronary artery disease, medication adherence, physical activity, dietary patterns, inflammatory biomarkers, menopausal status, and psychosocial factors, were not assessed. Their omission may have influenced the observed associations. Sixth, a data coding discrepancy was identified during manuscript revision and subsequently corrected through re-evaluation of source records and angiographic reports. Although all analyses were repeated following correction, this issue highlights the importance of rigorous data validation procedures in observational research. Finally, long-term clinical outcomes such as recurrent myocardial infarction, heart failure, repeat revascularization, and mortality were not evaluated. Consequently, the prognostic significance of TVCAD within this cohort could not be assessed. Future multicenter prospective studies with larger sample sizes and longitudinal follow-up are recommended to validate these findings and further explore predictors and outcomes of extensive coronary artery disease among NSTEMI patients.

Conclusion

Triple vessel coronary artery disease was identified in approximately one-third of patients presenting with non-ST-segment elevation myocardial infarction, indicating a substantial burden of advanced coronary atherosclerosis in this population. Male gender and smoking were independently associated with the presence of TVCAD, whereas associations with rural residence and socioeconomic status were attenuated after adjustment for potential confounding variables. These findings emphasize the importance of comprehensive cardiovascular risk assessment and early angiographic evaluation in NSTEMI patients, particularly among individuals with high-risk clinical profiles. Enhanced smoking cessation initiatives and targeted preventive strategies may contribute to reducing the burden of severe coronary artery disease and improving cardiovascular outcomes in this population.

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