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Total Coronary Artery Occlusion in Patients with Non - ST Elevation Myocardial Infarction

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Abstract

Background: Non–ST elevation myocardial infarction (NSTEMI) represents a heterogeneous clinical entity. A subset of NSTEMI patients harbor total or near-total coronary artery occlusion, often resembling STEMI equivalents, yet may not receive immediate invasive management. Early identification of high-risk angiographic patterns is crucial for optimizing outcomes.

Objective: To identify clinical, biochemical, electrocardiographic, and risk profile factors associated with total and near-total coronary artery occlusion among NSTEMI patients.

Methods: A cross-sectional study was conducted in the Department of Cardiothoracic and Vascular Surgery at AIMST University, Malaysia. A total of 200 consecutive NSTEMI patients undergoing coronary angiography were included. Demographic variables, cardiovascular risk factors, clinical presentation, ECG findings, troponin levels, echocardiographic parameters, and TIMI and HEART scores were recorded. Coronary angiography findings were classified as total/near total occlusion (≥90% stenosis) or non-critical lesions. Statistical analysis was performed using SPSS. Associations were assessed using Chi-square and independent t-tests. Multivariate logistic regression identified independent predictors of total occlusion. A p-value <0.05 was considered statistically significant.

Results: Total or near-total occlusion was observed in 78 patients (39%). Patients with occlusion had significantly higher troponin levels ($p < 0.001$), higher TIMI scores ($p = 0.002$), and more frequent anterior wall ischemic changes on ECG ($p = 0.004$). Diabetes mellitus ($p = 0.01$), smoking ($p = 0.003$), and delayed presentation ($p = 0.02$) were significantly associated with occlusion. On multivariate analysis, elevated troponin (AOR 3.6; $p < 0.001$), smoking (AOR 2.8; $p = 0.004$), high TIMI score (AOR 2.5; $p = 0.01$), and anterior ECG changes (AOR 3.1; $p = 0.002$) independently predicted total occlusion.

Conclusion: A substantial proportion of NSTEMI patients harbor total or near total coronary artery occlusion. Elevated troponin, high-risk clinical scores, smoking, and specific ECG changes may help identify NSTEMI patients who would benefit from early invasive strategies.

Keywords: NSTEMI; Coronary artery occlusion; TIMI score; Troponin; Risk stratification; STEMI equivalents.

Introduction

Acute coronary syndrome (ACS) encompasses a spectrum of clinical conditions ranging from ST-segment elevation myocardial infarction (STEMI) to non–ST elevation myocardial infarction (NSTEMI) and unstable angina. Among these, NSTEMI represents a heterogeneous and increasingly prevalent entity, accounting for a substantial proportion of hospital admissions for ACS worldwide [1]. Unlike STEMI, which is typically associated with complete coronary artery occlusion and characteristic electrocardiographic changes, NSTEMI is traditionally considered to result from partial or subtotal

occlusion of a coronary vessel. However, emerging evidence suggests that a significant subset of NSTEMI patients may harbor total or near total coronary artery occlusion despite the absence of classic ST-segment elevation [2,3].

The recognition of total occlusion in NSTEMI patients carries important therapeutic implications. Current guidelines recommend early invasive strategies for high-risk NSTEMI patients based on clinical risk scores such as TIMI and GRACE, as well as elevated cardiac biomarkers [4]. Nevertheless, electrocardiographic criteria alone may fail to identify patients with complete occlusion who might benefit from urgent reperfusion therapy comparable to STEMI management [5]. This concept has led to increasing discussion regarding "STEMI equivalents" within the NSTEMI population [6]. Several studies have investigated the prevalence of total occlusion in NSTEMI. Khan et al. [2] reported that approximately 25–35% of NSTEMI patients demonstrate complete occlusion of the culprit artery on coronary angiography. Similarly, Hung et al. [3] observed that occluded culprit arteries are not uncommon in NSTEMI and are associated with worse in-hospital outcomes. These findings challenge the traditional dichotomy between STEMI and NSTEMI and emphasize the need for improved risk stratification tools.

Cardiac biomarkers, particularly high-sensitivity troponin, play a central role in NSTEMI diagnosis and prognostication. Elevated troponin levels have been associated with greater thrombus burden and higher likelihood of significant coronary obstruction [7]. Additionally, electrocardiographic features such as anterior wall ischemic changes, dynamic ST depression, or specific patterns like the Aslanger sign may indicate underlying total occlusion even in the absence of ST elevation [6,8]. Echocardiographic findings, including regional wall motion abnormalities and reduced left ventricular ejection fraction, may further support the presence of extensive myocardial ischemia. Traditional cardiovascular risk factors also contribute to the severity of coronary lesions. Diabetes mellitus, smoking, dyslipidemia, and hypertension are strongly associated with plaque instability and thrombotic occlusion [9]. Jung et al. [10] demonstrated that certain clinical characteristics, including smoking and elevated cardiac enzymes, independently predicted total occlusion in NSTEMI patients. Moreover, risk scoring systems such as TIMI and HEART scores have been shown to correlate with angiographic severity and adverse outcomes [11].

Early identification of NSTEMI patients with total or near-total occlusion is essential to optimize management strategies. Delayed recognition may result in prolonged ischemia, increased myocardial necrosis, and impaired left ventricular function. Conversely, prompt invasive evaluation and revascularization may improve clinical outcomes and reduce complications [12]. Given the clinical and prognostic importance of detecting total coronary occlusion in NSTEMI, further evaluation of associated clinical, biochemical, electrocardiographic, and risk profile factors is warranted. Therefore, the present study was undertaken at AIMST University, Malaysia, to identify determinants associated with total and near-total coronary artery occlusion among patients diagnosed with NSTEMI. By clarifying these associations, this study aims to inform risk stratification strategies and guide early invasive decision-making in NSTEMI management.

Materials and Methods

Study Design

This cross-sectional observational study was conducted to determine the prevalence of total coronary artery occlusion and identify its clinical predictors among patients presenting with non-ST elevation myocardial infarction (NSTEMI). The study evaluated the association between clinical presentation, electrocardiographic findings, echocardiographic parameters, angiographic characteristics, and the presence of total coronary artery occlusion.

Study Setting and Duration

The study was conducted in the Department of Cardiothoracic and Vascular Surgery at AIMST University, Malaysia, a tertiary care referral center equipped with comprehensive cardiac diagnostic and interventional services. Consecutive eligible patients presenting during the predefined study period were recruited for the study.

Study Population

A total of 200 consecutive patients diagnosed with non-ST elevation myocardial infarction (NSTEMI) were included using purposive sampling. The diagnosis of NSTEMI was established based on clinical symptoms suggestive of myocardial ischemia, the absence of persistent ST-segment elevation on electrocardiography, and elevated cardiac troponin levels consistent with myocardial injury.

Sample Size

The study included a total sample of 200 eligible patients who fulfilled the inclusion criteria during the study period. The sample size was determined based on the availability of consecutive patients presenting to the tertiary care center.

Inclusion Criteria

Patients aged more than 18 years with a confirmed diagnosis of NSTEMI who underwent coronary angiography during the same hospital admission and had complete clinical, laboratory, electrocardiographic, echocardiographic, and angiographic data were included in the study.

Exclusion Criteria

Patients presenting with ST-segment elevation myocardial infarction, previous myocardial infarction, prior percutaneous coronary intervention, previous coronary artery bypass graft surgery, cardiac arrest at presentation, significant confounding comorbid illnesses, or incomplete clinical records were excluded from the study.

Data Collection Tool

Data were collected retrospectively from medical records, emergency department documentation, laboratory databases, electrocardiography reports, echocardiography findings, and coronary angiography records using a structured data collection form. Demographic variables included age, gender, ethnicity, educational status, occupation, and body mass index. Cardiovascular risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking status, alcohol consumption, and family history of coronary artery disease were documented. Clinical presentation variables included symptom onset, duration of chest pain, delay in hospital presentation, and admission vital signs. Electrocardiographic findings were categorized according to the presence of ST-segment depression, T-wave inversion, anterior wall ischemic changes, or nonspecific abnormalities. Peak cardiac troponin values were recorded. Echocardiographic assessment included left ventricular ejection fraction and the presence of regional wall motion abnormalities. Prognostic risk stratification was performed using the Thrombolysis in Myocardial Infarction (TIMI) risk score and the HEART score.

Coronary Angiographic Assessment

All patients underwent diagnostic coronary angiography through either radial or femoral arterial access according to institutional protocols. Total coronary artery occlusion was defined as 100% luminal obstruction with Thrombolysis in Myocardial Infarction (TIMI) grade 0 flow, while near-total occlusion was defined as ≥90% luminal stenosis associated with severely reduced distal coronary flow. Based on the angiographic findings, patients were categorized into the total/near-total occlusion group and the non-critical coronary lesion group for comparative analysis.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of the Department of Cardiothoracic and Vascular Surgery, AIMST University, Malaysia (Ref. No. AIMST/IEC/2024/73916). All participants received a detailed participant information sheet, and written informed consent was obtained prior to enrolment. Confidentiality and anonymity of patient information were strictly maintained throughout the study by assigning unique identification numbers and ensuring that no personally

identifiable information was disclosed during data collection, analysis, or publication.

Statistical Analysis

Data were entered into Microsoft Excel for coding and cleaning before being analyzed using the Statistical Package for the Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation and compared using the independent sample *t*-test. Categorical variables were summarized as frequencies and percentages and analyzed using the Chi-square test. Multivariate logistic regression analysis was performed to identify independent predictors of total coronary artery occlusion, and adjusted odds ratios with 95% confidence intervals were calculated. A *p*-value of less than 0.05 was considered statistically significant.

Results

A total of 200 NSTEMI patients underwent coronary angiography. Total or near-total coronary artery occlusion (≥90% stenosis) was identified in 78 patients (39%), while 122 patients (61%) had non-critical lesions.

Table 1: Baseline Demographic Characteristics

Variable	Total/Near Total Occlusion (n=78)	Non-Critical Lesion (n=122)	p-value
Mean Age (years)	61.2 ± 8.4	57.6 ± 9.1	0.01
Male (%)	71.8%	65.6%	0.34
BMI ≥25 kg/m² (%)	64.1%	52.5%	0.09

Patients with total or near-total occlusion were significantly older compared to those without critical lesions (p = 0.01). Although male predominance was observed in both groups, gender difference was not statistically significant. Higher BMI was more frequent in the occlusion group, but did not reach statistical significance. Age appears to be an important demographic determinant of severe angiographic disease.

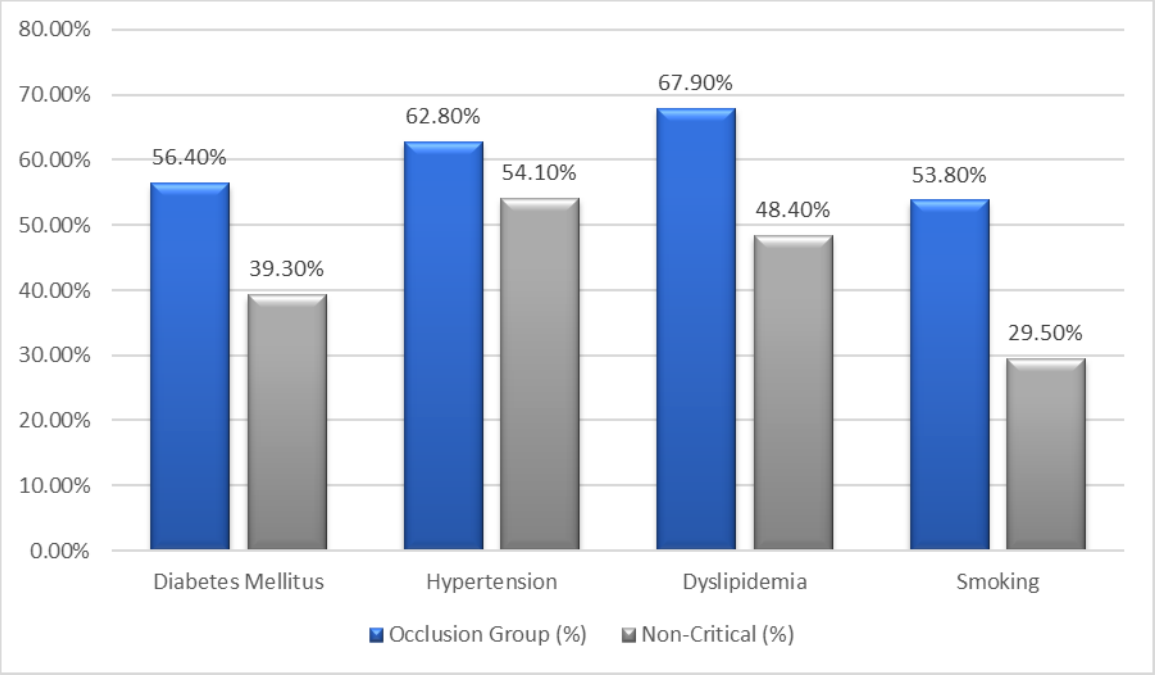

Figure 1: Cardiovascular Risk Factors

Diabetes mellitus (p = 0.01), dyslipidemia (p = 0.006), and smoking (p = 0.003) were significantly more prevalent in patients with total occlusion. Hypertension showed no significant association. These findings suggest that metabolic and behavioral risk factors strongly contribute to severe coronary obstruction in NSTEMI.

Table 3: Clinical Presentation Characteristics

Variable	Occlusion	Non-Critical	p-value
Delay >6 hours	58.9%	41.8%	0.02
Anterior ECG changes	48.7%	26.2%	0.004
Mean Heart Rate (bpm)	94 ± 14	86 ± 12	0.01

Delayed hospital presentation beyond six hours was significantly associated with total occlusion (p = 0.02). Anterior wall ECG changes were more frequent in the occlusion group (p = 0.004). Higher mean heart rate was also observed in these patients (p = 0.01), indicating greater hemodynamic stress.

Table 4: Laboratory and Echocardiographic Findings

Parameter	Occlusion	Non-Critical	p-value
Peak Troponin (ng/mL)	8.6 ± 3.2	4.1 ± 2.7	<0.001
LVEF (%)	42.3 ± 6.5	50.8 ± 7.1	<0.001
RWMA Present (%)	74.3%	46.7%	0.001

Smoking was observed in 41.4% of participants, indicating a major preventable contributor. Nearly three-fourths reported unhealthy dietary patterns, reflecting poor nutritional habits. Sedentary behavior was common in 42.9% of individuals. These lifestyle factors collectively amplify cardiovascular risk at a young age.

Table 5: Prognostic Risk Scores

Score	Occlusion	Non-Critical	p-value
Mean TIMI Score	4.8 ± 1.1	3.6 ± 1.0	0.002
Mean HEART Score	7.2 ± 1.3	5.9 ± 1.2	0.003

Multivariate analysis identified elevated troponin as the strongest independent predictor of total occlusion (AOR 3.6; p <0.001). Smoking and anterior ECG changes also showed strong independent associations. High TIMI score and diabetes remained significant predictors.

Table 6: Multivariate Logistic Regression – Independent Predictors of Total Occlusion

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Elevated Troponin	3.6	1.9–6.8	<0.001
Smoking	2.8	1.4–5.2	0.004
High TIMI Score	2.5	1.3–4.7	0.01
Anterior ECG Changes	3.1	1.6–5.9	0.002
Diabetes Mellitus	1.9	1.1–3.8	0.03

Nearly half (47.1%) of participants presented more than 6 hours after symptom onset. Only 20% sought care within the first three hours. Delayed presentation increases risk of myocardial damage and complications. This delay likely reflects inadequate symptom recognition and healthcare-seeking behavior.

Discussion

The present study evaluated determinants of total and near-total coronary artery occlusion among NSTEMI patients and found a high prevalence of severe obstruction at 39 percent. This supports evidence that NSTEMI is not uniformly a partial occlusion entity. Meyers et al. [13] and Khan et al. [14] similarly reported that a substantial proportion of NSTEMI patients have complete culprit artery occlusion. Advancing age was significantly associated with total occlusion, consistent with Jung et al. [15] and Hung et al. [16], likely reflecting cumulative atherosclerotic burden. Metabolic factors such as diabetes and

dyslipidemia were also significantly associated, aligning with Mustafic et al. [17] and guideline evidence [18], highlighting their role in complex coronary lesions.

Smoking emerged as a strong independent predictor, comparable to findings by Jung et al. [15] and Meyers et al. [13], underscoring its prothrombotic effects. Delayed presentation beyond six hours was significantly associated with total occlusion, supporting evidence from Lupu et al. [19] on the benefit of early invasive management. Anterior wall ischemic ECG changes independently predicted severe obstruction, consistent with Miyauchi et al. [20] and Kumar et al. [21]. Elevated peak troponin was the strongest independent predictor, paralleling observations by Morrow et al. [22] and Baro et al. [23]. Reduced ejection fraction and regional wall motion abnormalities were more common in the occlusion group, as noted by Mitsis and Gragnano [24]. Higher TIMI and HEART scores were also associated with total occlusion, supporting findings by Satilmisoglu et al. [25] and current recommendations [18] to integrate risk scores with clinical and biomarker assessment for early identification of high risk NSTEMI patients.

Conclusion

This study shows that a significant proportion of NSTEMI patients have total or near total coronary artery occlusion, challenging the view that NSTEMI reflects only partial obstruction. Advanced age, diabetes, smoking, elevated troponin, anterior ECG changes, and higher TIMI scores were associated with severe disease, with troponin as the strongest independent predictor. These findings fulfill the objective of identifying key determinants of total occlusion and highlight that reliance on ST segment criteria alone may miss complete obstruction. Integrating clinical factors, biomarkers, ECG findings, and risk scores can improve early recognition and guide timely invasive management to enhance outcomes.

Declaration
Conflict of interest: Nil
Funding: Nil

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