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Original Article

In-Hospital Outcomes of Patients with Non-ST Elevation Myocardial Infarction Undergoing Early Invasive Percutaneous Coronary Intervention

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Abstract

Objectives: This study aimed to assess the frequency of in-hospital outcomes among patients with Non-ST Elevation Myocardial Infarction (NSTEMI) undergoing early invasive Percutaneous Coronary Intervention (PCI).

Methodology: A cross-sectional study was conducted in the Adult Cardiology Department at the National Institute of Cardiovascular Diseases (NICVD) in Karachi, Pakistan, from August 2019 to February 2020. The study included 165 patients, both male and female, aged 40 to 75 years, who presented with NSTEMI and underwent early invasive PCI. All patients were either admitted through the emergency department or referred from outpatient services at NICVD. Comprehensive medical assessments were performed, and relevant medical history and clinical details were documented. PCI procedures were conducted under the supervision of experienced consultant cardiologists with over five years of procedural expertise. The primary outcomes evaluated were the incidence of cardiogenic shock, heart failure, and in-hospital mortality.

Results: Of the 165 patients included in the study, 125 (75.8%) were male, with a mean age of 56.6±7.72 years and a mean BMI of 26.5±3.8 kg/m². Hypertension was prevalent in 100 (60.6%) patients, while 78 (47.3%) had diabetes mellitus. A history of smoking was reported in 70 (42.4%) patients. Heart failure emerged as the most common in-hospital adverse outcome, occurring in 25 (15.2%) patients, followed by cardiogenic shock in 9 (5.5%) patients, and in-hospital mortality in 20 (12.1%) patients.

Conclusion: Among patients undergoing early invasive PCI following NSTEMI, heart failure was the most frequent adverse in-hospital outcome, followed by mortality and cardiogenic shock. These findings underscore the importance of vigilant monitoring and management of high-risk NSTEMI patients during the early stages of PCI intervention.

Keywords: Diabetes mellitus, hypertension, Non-ST Elevation Myocardial Infarction, percutaneous coronary intervention, smoking

INTRODUCTION

Non-ST elevation myocardial infarction (NSTEMI) is a common and serious cause of hospitalization among patients with acute coronary syndrome (ACS) [1,2]. It represents an acute ischemic event that leads to myocyte necrosis, often characterized by symptoms similar to unstable angina, including chest discomfort [3]. However, NSTEMI is distinguished from unstable angina by a dynamic rise in troponin levels above the 99th percentile. While initial electrocardiograms (ECGs) in NSTEMI patients may show ischemic changes such as ST depression, T-wave inversion, or transient ST elevation, these findings can be subtle, nonspecific, or even absent, making diagnosis challenging.

The underlying pathology of NSTEMI involves a sudden imbalance between myocardial oxygen supply and demand, typically due to reduced myocardial perfusion caused by subtotal coronary artery blockage. Despite this, there is still a lack of robust statistical data to fully support the routine use of emergency angioplasty in NSTEMI patients [4-8]. Although the ECG is a critical tool for differentiating NSTEMI from ST-elevation myocardial infarction (STEMI), it has limitations in detecting acute myocardial infarction (AMI) and coronary artery occlusion [9]. Recent studies have shown that even in the absence of ST elevation, totally occluded coronary arteries (OCAs) may be identified via angiography, underscoring the potential for significant coronary artery obstruction in NSTEMI patients without overt ECG changes [10].

Delayed angiography and revascularization in NSTEMI patients, particularly those with occluded coronaries, have been associated with irreversible myocardial damage and worsened outcomes [11]. However, data on the frequency and distribution of OCAs in NSTEMI and the impact on patient outcomes remain limited [12]. Current evidence suggests that cardiogenic shock, heart failure, and mortality are among the most prevalent adverse outcomes in NSTEMI patients, with rates of 53.3%, 16.4%, and 12.22%, respectively.

Given the high prevalence of cardiovascular diseases in the South Asian population and the associated increased mortality rates, often due to treatment delays, there is an urgent need for timely and effective management of NSTEMI. This study aims to address this gap by determining the frequency of in-hospital outcomes in NSTEMI patients undergoing early invasive percutaneous coronary intervention, thereby contributing to improved treatment strategies and patient outcomes in this high-risk population.

METHODOLOGY

Study Design: This study was designed as a cross-sectional analysis aimed at evaluating the clinical outcomes, specifically cardiogenic shock, heart failure, and mortality, in patients diagnosed with non-ST elevation myocardial infarction (NSTEMI) who underwent early invasive percutaneous coronary intervention (PCI). The study was conducted over a period of six months, from August 2019 to February 2020.

Setting: The research was performed at the Adult Cardiology Department of the National Institute of Cardiovascular Diseases (NICVD) in Karachi, Pakistan. NICVD is a tertiary care hospital specializing in cardiovascular diseases, providing a comprehensive setting for managing and studying acute coronary syndromes.

Participants: A total of 165 patients, both male and female, aged between 40 and 75 years, diagnosed with NSTEMI and undergoing early invasive PCI, were included in the study. Patients were selected using non-probability consecutive sampling. Informed and written consent was obtained from all participants or their caregivers (next of kin) prior to their inclusion in the study. Approval for the study was obtained from the Institutional Ethical Committee.

- **Inclusion Criteria:** The inclusion criteria for this study were patients diagnosed with non-ST elevation myocardial infarction (NSTEMI) who underwent early invasive percutaneous coronary intervention (PCI). Additionally, the study included participants aged between 40 and 75 years.
- **Exclusion Criteria:** Exclusion criteria were carefully defined to ensure the selection of a homogenous patient population. Patients with dextrocardia, those dependent on hemodialysis due to chronic kidney disease, individuals with severe anemia (hemoglobin levels <7g/dl), or those presenting with an ejection fraction <20% were excluded. Furthermore, patients with a history of circulatory collapse and those who had

previously undergone heart surgery were also excluded from the study.

Variables

- **Primary Outcomes:** The primary outcomes of the study focused on assessing cardiogenic shock, heart failure, and mortality in patients with non-ST elevation myocardial infarction (NSTEMI). Cardiogenic shock was determined by sustained hypotension, defined as a systolic blood pressure of less than 90 mmHg lasting for at least 30 minutes, accompanied by a reduced cardiac index of less than 2.2 L/min/m², in the presence of an elevated pulmonary capillary occlusion pressure exceeding 15 mmHg, as measured by echocardiography. Heart failure was evaluated through a combination of clinical history, physical examination, and echocardiographic assessment, with a specific focus on patients with an ejection fraction (EF) of less than 50%. Mortality was defined as the in-hospital death of a patient occurring within two days of hospitalization.

- **Secondary Variables:** Several secondary variables were analyzed to understand their potential impact on the study's outcomes. Hypertension was defined as a systolic blood pressure greater than 130 mmHg or a diastolic blood pressure greater than 80 mmHg, or the use of antihypertensive medication for more than six months. Diabetes mellitus was identified by fasting plasma glucose levels exceeding 6.5 mmol/L (126 mg/dl), 2-hour postprandial glucose levels greater than 10 mmol/L (180 mg/dl), or the use of antidiabetic medication for over six months. The presence of ischemic heart disease in first-degree relatives was documented as a positive family history, providing insight into the genetic predisposition of the patients.

Data Sources/Measurement: All eligible patients either presenting to the emergency department or outpatient clinic at NICVD were subjected to a thorough medical history and clinical examination. Diagnostic criteria for NSTEMI included typical chest pain lasting more than 20 minutes, with or without ST-segment depression or T-wave inversion on ECG, and elevated cardiac troponin levels (>0.5 µg/ml). Cardiogenic shock and heart failure were assessed using standardized hemodynamic and echocardiographic parameters. Data were collected on structured forms and entered into a secure database for analysis.

Bias: Efforts were made to minimize bias by utilizing consecutive sampling to ensure all eligible patients were included without selection bias. Moreover, all PCI procedures were performed by experienced cardiologists, ensuring uniformity in treatment and reducing performance bias.

Study Size: The sample size of 165 patients was calculated based on a reported mortality rate of 12.2% in NSTEMI patients, with a 95% confidence level and a 5% margin of error. The sample size was deemed sufficient to detect clinically significant differences in outcomes.

Quantitative Variables: The study analyzed quantitative variables including age, weight, height, and body mass index (BMI). The clinical outcomes of cardiogenic shock, heart failure, and mortality were also quantitatively assessed.

Statistical Methods: Data were analyzed using IBM-SPSS Statistics, version 26.0. Continuous variables such as age, weight, height, and BMI were expressed as mean ± standard deviation (SD). Categorical variables including gender, hypertension, diabetes mellitus, smoking status, family history of heart disease, and clinical outcomes (cardiogenic shock, heart failure, and mortality) were presented as frequencies and percentages. Stratified analysis was conducted to evaluate the impact of confounders such as age, gender, hypertension, family history of heart disease, BMI, and smoking status on the outcomes. A p-value <0.05 was considered statistically significant for all analyses.

RESULTS

Participants: This study included a total of 165 patients diagnosed with non-ST elevation myocardial infarction (NSTEMI) who underwent early invasive percutaneous coronary intervention (PCI). Among these participants, 125 (75.8%) were male, and 40 (24.2%) were female. The mean age of the participants was 56.6 ± 7.72 years, with the majority (69.7%) being between the ages of 40 and 60 years. The average body mass index (BMI) of the patients was 26.5 ± 3.8 kg/m², with 60.6% of patients having a

BMI within the range of 17-26 kg/m², while the remaining 39.4% had a BMI above 26 kg/m².

Descriptive Data: The baseline characteristics of the NSTEMI patients are detailed in Table 1. Hypertension was observed in 100 (60.6%) patients, making it the most prevalent comorbidity. Diabetes mellitus was present in 78 (47.3%) of the participants, while 70 (42.4%) had a history of smoking. Additionally, 42 (25.5%) patients reported a family history of ischemic heart disease. These characteristics reflect a population with significant cardiovascular risk factors, contributing to the development of NSTEMI.

Table 1: Characteristics of NSTEMI Patients

Characteristics	Summary
Total (N)	**165**
Gender	
Male	125 (75.8%)
Female	40 (24.2%)
Age (years)	
40-60	115 (69.7%)
>60	50 (30.3%)
Body mass index (kg/m²)	
17-26	100 (60.6%)
>26	65 (39.4%)
Comorbidities	
Hypertension	100 (60.6%)
Diabetes mellitus	78 (47.3%)
History of smoking	70 (42.4%)
Family history of heart disease	42 (25.5%)

Outcome Data: The in-hospital adverse outcomes among the study participants were noteworthy, with heart failure emerging as the most frequent complication, affecting 25 (15.2%) patients. Cardiogenic shock was observed in 9 (5.5%) patients, while mortality occurred in 20 (12.1%) patients within two days of hospitalization. These outcomes underscore the severity of NSTEMI in the studied population, highlighting the need for vigilant monitoring and prompt management.

Main Results: The stratification of study variables revealed important associations between patient characteristics and the primary outcomes of cardiogenic shock, heart failure, and mortality. The incidence of cardiogenic shock did not significantly differ by gender, age, BMI, hypertension, diabetes, smoking status, or family history of heart disease (Table 2). Similarly, the occurrence of heart failure showed no significant association with most variables, except for a positive family history of heart disease, which was significantly more common among those who developed heart failure (p = 0.005) (Table 3). In terms of mortality, no statistically significant differences were observed across the studied variables, although older age and hypertension appeared more frequently among those who died (Table 4).

Table 2: Stratification of study variables with cardiogenic shock

Characteristics	Cardiogenic Shock		P-value
	Yes (n=9)	No (n=156)	
Gender			
Male	7 (77.8%)	118 (75.6%)	0.622
Female	2 (22.2%)	38 (24.4%)	
Age (years)			
40-60	5 (55.6%)	110 (70.5%)	0.273
>60	4 (44.4%)	46 (29.5%)	
Body mass index (kg/m²)			
17-26	5 (55.6%)	95 (70.5%)	0.503
>26	4 (44.4%)	61 (39.1%)	
Comorbidities			
Hypertension	6 (66.7%)	94 (60.3%)	0.497
Diabetes mellitus	5 (55.6%)	75 (48.1%)	0.662
History of smoking	4 (44.4%)	66 (42.3%)	0.58
Family history of heart disease	3 (33.3%)	39 (25.0%)	0.412

Table 3: Stratification of study variables with heart failure

Characteristics	Heart Failure		P-value
	Yes (n=25)	No (n=140)	
Gender			
Male	18 (72.0%)	107 (76.4%)	0.634
Female	7 (2.0%)	33 (23.6%)	
Age (years)			
40-60	15 (60.0%)	100 (71.4%)	0.252
>60	10 (40.0%)	40 (28.6%)	
Body mass index (kg/m²)			
17-26	16 (64.0%)	84 (60.0%)	0.706
>26	9 (36.0%)	56 (40.0%)	
Comorbidities			
Hypertension	17 (68.0%)	83 (59.3%)	0.277
Diabetes mellitus	16 (64.0%)	70 (50.0%)	0.197
History of smoking	14 (56.0%)	56 (40.0%)	0.136
Family history of heart disease	12 (48.0%)	30 (21.4%)	0.005

Figure 1: Frequency of Adverse In-Hospital Outcomes in Patients of NSTEMI

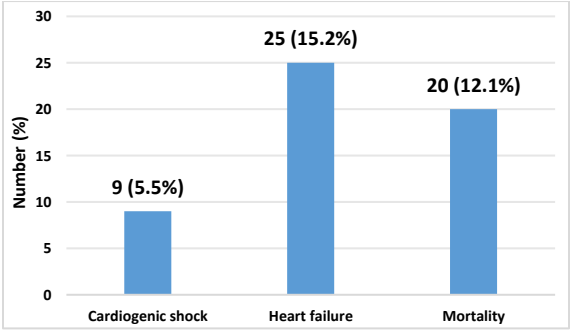

Table 4: Stratification of study variables with mortality

Characteristics	Mortality		P-value
	Yes (n=20)	No (n=145)	
Gender			
Male	15 (75.0%)	110 (75.9%)	0.562
Female	5 (25.0%)	35 (24.1%)	
Age (years)			
40-60	11 (55.5%)	104 (71.7%)	0.127
>60	9 (45.0%)	41 (28.3%)	
Body mass index (kg/m^2)			
17-26	13 (65.0%)	87(60.0%)	0.668
>26	7 (35.0%)	58 (40.0%)	
Comorbidities			
Hypertension	14 (70.0%)	86 (59.3%)	0.359
Diabetes mellitus	9 (45.0%)	69(47.6%)	0.828
History of smoking	9 (45.0%)	61 (42.1%)	0.804
Family history of heart disease	7 (35.0%)	35 (24.1%)	0.296

DISCUSSION

The treatment of non-ST elevation myocardial infarction (NSTEMI) has significantly evolved over the past few decades, with an increasing number of patients undergoing coronary angiography and percutaneous coronary intervention (PCI) [13]. Modern practice guidelines recommend urgent catheterization for patients presenting with NSTEMI, especially when ischemic symptoms persist or when there is hemodynamic or electrical instability, both of which are considered major risk factors for myocardial infarction (MI) [12]. The findings of our study align with those of Khera et al. [14], which demonstrated that early PCI across all age groups is associated with significantly reduced in-hospital mortality and shorter hospital stays. Notably, our study did not find a significant association between gender and adverse outcomes, a result consistent with other research indicating that gender does not significantly influence in-hospital outcomes for NSTEMI patients undergoing PCI [15].

A local study published in 2019 highlighted the complications among patients with non-ST elevation acute coronary syndrome (NSTE-ACS) who did not undergo revascularization. Pulmonary edema was the most common complication, observed in 65.3% of patients, followed by cardiogenic shock in 49.7%, and mortality in 48.5%. While there is considerable data on the outcomes of patients with ST-elevation myocardial infarction (STEMI) who undergo coronary revascularization, there has been a notable lack of local data in recent years documenting complications among NSTE-ACS patients following early invasive PCI [16].

In our study, we found that cardiogenic shock occurred in 5.5% of patients, heart failure in 15.2%, and mortality in 12.1% of patients. These results are somewhat consistent with those reported by Karwowski et al., who found that 7.8% of patients undergoing PCI experienced heart failure. Hochman et al. reported a much higher mortality rate of 60% in patients undergoing PCI, which may be due to differences in study populations and methodologies [17]. Additionally, a 2021 study evaluating early versus delayed coronary revascularization reported a mortality rate of 3.1% in the early invasive group, highlighting the potential benefits of prompt intervention [18]. Another study published in 2023 reported complication rates among NSTE-ACS patients without revascularization, including cardiogenic shock (1.7%), pulmonary edema (25.2%), and in-hospital mortality (4.2%) [19].

Our findings suggest that while the organizational model for managing NSTEMI should be continuously reviewed and improved, it is also critical to emphasize individualized clinical assessments alongside standard protocols. Patients with NSTEMI who do not undergo an invasive strategy may be overlooked in such models, underscoring the need for a balanced approach.

Limitations

Despite the promising outcomes associated with increased revascularization rates and reduced mortality and hospital stays, it is important to acknowledge the limitations of our study. Being a single-center study with a relatively modest sample size, our results should be interpreted with caution, and further research involving larger cohorts is necessary to confirm our findings.

CONCLUSION

The study concludes that early invasive percutaneous coronary intervention (PCI) in patients with non-ST elevation myocardial infarction (NSTEMI) is associated with favorable in-hospital outcomes, including a relatively low incidence of cardiogenic shock, heart failure, and mortality. These findings underscore the importance of timely intervention in managing NSTEMI, particularly in high-risk patients. However, the study also highlights the need for individualized patient assessment alongside standard treatment protocols, as well as the importance of

further research with larger sample sizes to validate these results and refine treatment strategies.

AUTHORS' CONTRIBUTION

FS, GI, GK, MH, MS, RQ, and KFA: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. FS, GI, GK, MH, MS, RQ, and KFA: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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REFERENCES

1. Gilutz H, Shindel S, Shoham-Vardi I. Adherence to NSTEMI Guidelines in the emergency department: regression to reality. Crit Pathw Cardiol. 2019;18(1):40-6.
2. Donoghue MO, Boden W, Braunwald E, Cannon CP, Clayton TC, de Winter RJ, et al. Early invasive versus conservative treatment strategies in women and men with unstable angina and non-ST-elevation myocardial infarction. JAMA. 2008;300(1):71-80.
3. Amsterdam EA, Wenger NK, Brindis RG, Casey DE, Ganiats TG, Holmes DR, et al. 2014 AHA/ACC guideline for the management of patients with non-ST elevation acute coronary syndromes: a report of the American College of Cardiology / American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2014;64(24):e139-228.
4. Kim MC, Ahn Y, Rhew SH, Jeong MH, Kim JH, Hong YJ, et al. Impact of total occlusion of an infarct related artery on long-term mortality in acute non-ST-elevation myocardial infarction patients who underwent early percutaneous coronary intervention. Int Heart J. 2012;53(3):160-4.
5. Shin DI, Chang K, Ahn Y, HWANG BH, PARK HJ, Seo SM, et al. Impact of occluded culprit arteries on long-term clinical outcome in patients with Non-ST-elevation myocardial infarction: 48 months follow-up results in the COREA-AMI registry. J Interv Cardiol. 2014;27(1):12-20.
6. Hanssen M, Cottin Y, Khalife K, Hammer L, Goldstein P, Puymirat E, et al. French Registry on Acute ST elevation and non ST elevation myocardial infarction 2010. FAST-MI 2010. Heart. 2012;98(9):699-705.
7. Roe MT, White JA, Kaul P, Tricoci P, Lokhnygina Y, Miller CD, et al. Regional Patterns of Use of a medical management strategy for patients with non-ST-segment elevation 106 acute coronary syndromes insights from the early ACS Trial. Circ Cardiovasc Qual Outcomes. 2012; 5:205-13.
8. Karwowski J, Poloński L, Gierlotka M, Gąsior M, Bęćkowski M, Kowalik I, et al. Post procedural TIMI how grade 2 is not associated with improved prognosis in patients with non-ST-segment elevation myocardial infarction undergoing percutaneous coronary revascularization (PL-ACS registry). Cardiol J. 2016;23(4):402-10.
9. Aijaz S, Hanif B. Frequency and distribution of angiographically occluded coronary artery and in hospital outcome of patients with non ST elevation myocardial infarction. J Pak Med Assoc. 2016;66(5):504-8.
10. Khera S, Kolte D, Aronow WS, Palaniswamy C, Subramanian KS, Hashim T, et al. Non-ST elevation myocardial infarction in the United States: contemporary trends in incidence, utilization of the early imresive strategy, and in-hospital outcomes. J Am Heart Assoc. 2014;3(4):e000995.
11. Uddin S, Ullah A. Cardiogenic shock in adult patients with non-ST elevation myocardial infarction. Khyber Med Univ J. 2013;5(4):199-202.
12. Leng W, Yang J, Fan X, Sun Y, Xu H, Gao X, et al. Contemporary invasive management and in-hospital outcomes of patients with non-ST-segment elevation myocardial infarction in China: findings from China Acute Myocardial Antarction (CAMI) registry. Am Heart J. 2019;215:1-11.
13. Nguyen TM, Melichova D, Aabel EW, Lie OH, Klaeboe LG, Brenne B, et al. Mortality in Patients with Acute Coronary Syndrome-A Prospective 5-Year Follow-Up Study. J Clin Med. 2023;12(20):6598.
14. Khera S, Kolte D, Aronow WS, Palaniswamy C, Subramanian KS, Hashim T, et al. Non-ST elevation myocardial infarction in the United States: contemporary trends in incidence, utilization of the early invasive strategy, and in-hospital outcomes. J Am Heart Assoc. 2014;3(4):e000995.
15. Heer T, Gitt AK, Juenger C, Schiele R, Wienbergen H, Towae F, et al. Gender differences in acute non-ST-segment elevation myocardial infarction. Am J Cardiol. 2006;98(2):160-6.
16. Akbar FE, Khan SB, Ali U. Short term clinical outcomes in non ST segment elevation myocardial infarction patients with high thrombolysis in myocardial infarction (TIMI) risk score. Pak Heart J. 2019;52(4):327-32.
17. Hochman JS, Buller CE, Sleeper La, Boland J, Dzavik V, Sanborn Ta, et al. cardiogenic shock complicating acute myocardial infarction - etiologies, management and outcome: a report from the SHOCK Trial Registry. J Am Col Cardiol. 2000;36(3 supplement 1):1063-70.
18. Islam R, Ahsan SA, Mandal MRM, Ahasan MH, Rahman AF, Amin MR, et al. Immediate hospital outcome after early invasive versus delayed ischaemia driven percutaneous coronary intervention in non-ST elevated myocardial infarction. J Investigat Clin Cardiol. 2021;3(1):24-31.
19. Khan M, Shabbir M, Shabbir A, Paiker S, Hussain Z, Siddiqui A, et al. Comparison of short-term in-hospital outcomes in patients presenting with ST-elevation myocardial infarction versus non-ST-elevation myocardial infarction. Pak Arm Forces Med J. 2023;73:(Suppl-3)522.