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RESEARCH ARTICLE

A Prospective Study of Clinical Outcomes and Electrocardiographic Changes in Diabetic Patients Following Primary Percutaneous Coronary Intervention for Acute Myocardial Infarction

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Abstract: A prospective observational study was carried out at Apollo Hospital, Kakinada, to evaluate the clinical outcomes of diabetic patients undergoing primary percutaneous coronary intervention (PCI) for acute myocardial infarction (MI). The study included 100 diabetic patients with acute MI over a 6-month period from October 2024 to February 2025. The study documented demographic characteristics, clinical presentations, electrocardiographic changes, and ejection fraction measurements at admission and discharge. Males constituted 61% of the study population, with the majority of patients (33%) falling in the 50-60 years age group. Anterior wall MI was predominant (58%) compared to inferior wall MI (42%). Acute onset chest pain was the primary presenting symptom in 33% of patients. At admission, 55% of patients showed ECG ST-segment elevation of 2-4 mm, while 45% showed elevation greater than 4 mm. Post-intervention assessment at discharge revealed significant improvement, with 47% of patients showing ST-segment elevation less than 2 mm. Similarly, left ventricular ejection fraction improved from baseline, with 49% of patients achieving 45-55% ejection fraction at discharge. The study showed that primary PCI effectively improved cardiac function in diabetic patients with acute MI, as evidenced by resolution of ST-segment elevation and enhancement in left ventricular function.

Keywords: Acute Myocardial Infarction; Diabetes Mellitus; Primary Percutaneous Coronary Intervention; Electrocardiogram; Left Ventricular Function.

1. Introduction

Myocardial infarction (MI) is characterized by myocardial cell death due to prolonged ischemia [1]. The coexistence of diabetes mellitus significantly amplifies the complexity of MI management and influences patient outcomes [2]. Diabetic patients experience more severe coronary artery disease, higher rates of complications, and poorer prognosis following MI compared to non-diabetic individuals [3]. The pathophysiological relationship between diabetes and MI involves multiple mechanisms. Diabetes accelerates atherosclerosis through endothelial dysfunction, inflammatory processes, and abnormal platelet function [4]. The metabolic derangements in diabetes, including hyperglycemia, insulin resistance, and dyslipidemia, create a pro-thrombotic and pro-inflammatory environment that increases the risk of acute coronary events [5]. Acute MI in diabetic patients presents unique challenges in diagnosis and management. The clinical presentation may be atypical, with silent ischemia being more common due to autonomic neuropathy [6]. These patients often present with more extensive coronary artery disease and have a higher incidence of multi-vessel involvement [7]. Primary percutaneous coronary intervention (PCI) has emerged as the preferred reperfusion strategy for acute MI, particularly in diabetic patients [8]. The procedure involves immediate mechanical restoration of coronary blood flow through balloon angioplasty and stent placement. Compared to fibrinolysis, primary PCI offers several advantages, including higher rates of successful reperfusion, lower risk of bleeding complications, and reduced mortality [9]. Despite advancements in interventional techniques and adjunctive pharmacotherapy, diabetic patients continue to experience worse outcomes following primary PCI compared to non-diabetic individuals [10]. Limited data exists regarding the immediate post-procedural outcomes and electrocardiographic changes in this high-risk population, particularly in the Indian context [11]. The primary objective of this study was to evaluate the clinical outcomes of diabetic patients undergoing primary PCI for acute MI.

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2. Materials and Methods

2.1. Study Design

This prospective observational study was conducted at Apollo Hospital, Kakinada, Andhra Pradesh, India, over a six-month period from October 2024 to February 2025. The study protocol was approved by the institutional ethics committee (IEC/KCPT/2023-24/121), and written informed consent was obtained from all participants [12].

2.2. Study Population

The study enrolled 100 consecutive diabetic patients who presented with acute myocardial infarction and underwent primary PCI. Patient selection followed strict inclusion and exclusion criteria to maintain study homogeneity and reliability [13].

2.2.1. Inclusion Criteria

Patients aged 25 years or older with established Type 1 or Type 2 diabetes mellitus who presented with acute MI were included in the study. The diagnosis of MI was based on typical symptoms including chest pain, radiating pain, or dyspnea, accompanied by diagnostic ECG changes showing ST-segment elevation ≥ 0.1 mV or ST-segment depression ≥ 0.1 mV. Both STEMI and NSTEMI cases were included in the study population [14].

2.2.2. Exclusion Criteria

The study excluded patients younger than 25 years, pregnant or lactating women, and those with chronic kidney disease. Patients with contraindications to standard MI medications or those participating in other clinical trials were not enrolled. Additionally, patients unable to provide informed consent were excluded from the study [15].

2.3. Data Collection

A standardized data collection form was developed to ensure systematic documentation of patient information. The form captured detailed demographic data, medical history, clinical presentations, and laboratory investigations. Patient assessment was performed at two critical time points: admission and discharge [16].

2.3.1. Clinical Parameters

Comprehensive clinical evaluation included detailed documentation of presenting symptoms, past medical history, and social history. Special attention was given to recording the nature and duration of chest pain, associated symptoms, and risk factors for coronary artery disease [17].

2.3.2. Laboratory Investigations

Standard laboratory parameters were measured, including complete blood count, cardiac biomarkers, blood glucose levels, renal function tests, and coagulation profile. These investigations were conducted using standardized laboratory protocols and quality control measures [18]

2.3.3. Electrocardiographic Analysi

Serial 12-lead electrocardiograms were recorded at admission and discharge using standardized recording protocols. ECG analysis focused on ST-segment elevation patterns, measuring the magnitude of elevation in millimeters from the isoelectric line. The location and extent of ST-segment changes were documented to classify the type of myocardial infarction (anterior or inferior wall) [19].

2.3.4. Cardiac Function

Left ventricular function was assessed through two-dimensional echocardiography at admission and discharge. Ejection fraction was calculated using the modified Simpson's method. The analysis included evaluation of regional wall motion abnormalities and other structural parameters [20].

2.4. Primary PCI Procedure

2.4.1. Pre-procedural Management

All patients received standard pre-procedural medications including dual antiplatelet therapy with aspirin and clopidogrel, along with appropriate doses of anticoagulation. Blood glucose levels were monitored and managed according to established protocols [21].

2.4.2. Interventional Procedure

Primary PCI was performed via femoral or radial arterial access based on individual patient characteristics. The procedure involved initial coronary angiography followed by mechanical revascularization of the infarct-related artery. Stent selection and deployment techniques followed current interventional cardiology guidelines [22].

2.4.3. Post-procedural Care

Following the intervention, patients were monitored in the cardiac care unit. Post-procedural care included continuous ECG monitoring, regular assessment of vital parameters, and optimization of medical therapy [23].

2.5. Statistical Analysis

Statistical analysis was performed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparative analysis of admission and discharge parameters was conducted using paired statistical tests [24].

3. Results

3.1. Demographic Characteristics

3.1.1. Age

The study population demonstrated a wide age distribution ranging from 30 to 90 years. The highest prevalence of acute myocardial infarction was observed in the 50-60 years age group, comprising 33% of the total cases. The second largest group was patients aged 40-50 years (29%), followed by those aged 60-70 years (19%). The remaining age distribution included 10% in the 70-80 years group, 5% in the 30-40 years group, and 4% in the 80-90 years group [25].

Table 1. Age Distribution of Patients with Diabetic Myocardial Infarction

Age Group (years)	Number of Patients (n)	Percentage (%)
30-40	5	5
40-50	29	29
50-60	33	33
60-70	19	19
70-80	10	10
80-90	4	4
Total	100	100

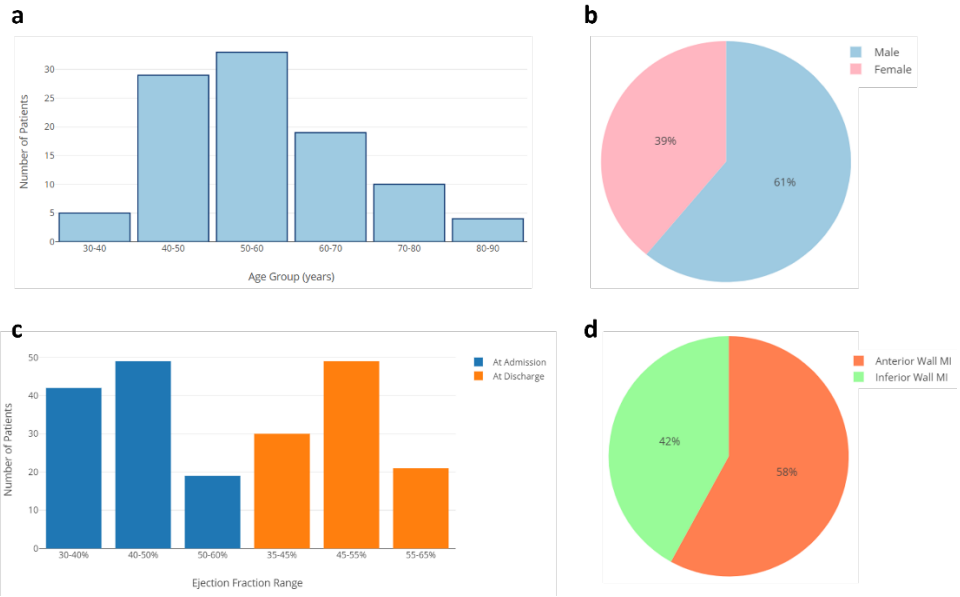

Figure 1. a. Distribution of Age b. Distribution of Gender c. Ejection Fraction d. Distribution of MI

Table 2. Gender Distribution

Gender	Number of Patients (n)	Percentage (%)
Male	61	61
Female	39	39
Total	100	100

3.1.2. Gender

The study revealed a predominance of male patients, with 61 males (61%) compared to 39 females (39%). This gender disparity aligns with previously reported epidemiological patterns in acute coronary syndromes [26].

3.2. Clinical Presentation

3.2.1. Social History

The majority of patients (86%) reported no significant harmful social habits. Among those with documented social habits, 7% were occasional alcohol consumers, 4% were regular alcohol consumers, and 3% reported both alcohol consumption and smoking [27].

Table 3. Distribution of social habits among study participants

Social Habits	Number of Patients (n)	Percentage (%)
No significant habits	86	86
Occasional alcohol	7	7
Regular alcohol	4	4
Alcohol and smoking	3	3
Total	100	100

3.2.2. Presenting Symptoms

The most frequent presenting symptom was acute onset chest pain, observed in 33% of patients. Other presenting symptoms included mild chest pain (15%), isolated dyspnea (4%), and palpitations (4%). Combined symptoms were also noted, with chest pain and palpitations occurring in 5% of cases, dyspnea and chest pain in 9%, and retrosternal chest pain in 3%. A smaller proportion of patients (3%) presented with a combination of chest pain, dyspnea, and palpitations [28].

Table 4. Distribution of Presenting Symptoms

Symptoms	Number of Patients (n)	Percentage (%)
Acute onset chest pain	33	33
Mild chest pain	15	15
Isolated dyspnea	4	4
Palpitations	4	4
Chest pain and palpitations	5	5
Dyspnea and chest pain	9	9
Retrosternal chest pain	3	3
Chest pain, dyspnea, and palpitations	3	3
Others	24	24
Total	100	100

3.3. Myocardial Infarction

The analysis of infarction patterns revealed that anterior wall myocardial infarction (AWMI) was more prevalent, occurring in 58% of cases, while inferior wall myocardial infarction (IWMI) was observed in 42% of patients [29].

Table 5. Distribution of myocardial infarction patterns

MI Pattern	Number of Patients (n)	Percentage (%)
AWMI	58	58
IWMI	42	42
Total	100	100

3.4. Electrocardiographic Findings

3.4.1. During Admission

At the time of admission, ECG analysis revealed that 55% of patients presented with ST-segment elevation between 2-4 mm, while 45% showed elevation greater than 4 mm. No patients presented with ST-segment elevation less than 2 mm, indicating the acute nature of the cardiac events [30].

Table 6. ECG Measurements at Admission

ST-segment Elevation	Number of Patients (n)	Percentage (%)
< 2 mm	0	0
2-4 mm	55	55
> 4 mm	45	45
Total	100	100

3.4.2. At Discharge

Post-intervention ECG assessment at discharge demonstrated significant improvement in ST-segment elevation patterns. The proportion of patients with ST-segment elevation between 2-4 mm decreased to 53%, while 47% of patients showed resolution with elevation less than 2 mm. Notably, no patients had ST-segment elevation greater than 4 mm at discharge, indicating successful intervention outcomes [31].

Table 7. ECG Measurements at Discharge

ST-segment Elevation	Number of Patients (n)	Percentage (%)
< 2 mm	47	47
2-4 mm	53	53
> 4 mm	0	0
Total	100	100

3.5. Left Ventricular Function

3.5.1. Admission Ejection Fraction

Initial echocardiographic evaluation revealed compromised left ventricular function in the majority of patients. The ejection fraction (EF) distribution at admission showed 42% of patients with EF between 30-40%, 49% with EF between 40-50%, and 19% with EF between 50-60% [32].

Table 8. Distribution of ejection fraction at admission

Ejection Fraction Range	Number of Patients (n)	Percentage (%)
30-40%	42	42
40-50%	49	49
50-60%	19	19
Total	100	100

3.5.2. Discharge Ejection Fraction

Follow-up assessment of left ventricular function at discharge showed marked improvement. The distribution shifted favorably, with 30% of patients showing EF between 35-45%, 49% between 45-55%, and 21% between 55-65%. This improvement in ejection fraction parameters indicates successful myocardial recovery following primary PCI [33].

Table 9. Distribution of ejection fraction at discharge

Ejection Fraction Range	Number of Patients (n)	Percentage (%)
35-45%	30	30
45-55%	49	49
55-65%	21	21
Total	100	100

3.6. Clinical Outcomes

The immediate post-procedural period showed favorable outcomes in the majority of patients. The successful restoration of coronary flow through primary PCI was associated with significant improvement in both electrocardiographic parameters and left ventricular function. These improvements were reflected in the resolution of ST-segment elevation and enhancement of ejection fraction measurements [34].

4. Discussion

Our study showed significant demographic patterns in diabetic patients presenting with acute myocardial infarction. The predominance of cases in the 50-60 years age group aligns with existing literature on premature coronary artery disease in diabetic populations. The male preponderance (61%) observed in our study corresponds with established epidemiological data, although the gender gap appears narrower compared to previous studies, possibly reflecting changing lifestyle patterns and increasing cardiovascular risk factors among women in the Indian population [35].

The diversity of presenting symptoms in our study population merits careful consideration. While typical anginal symptoms remained the most common presentation, the significant proportion of patients with atypical presentations (28%) highlights the challenging nature of diagnosis in diabetic patients. This finding emphasizes the need for heightened clinical suspicion and comprehensive evaluation in diabetic patients presenting with unusual symptoms [36]. The significant improvement in ST-segment elevation patterns from admission to discharge (with 47% achieving resolution to <2mm) suggests effective myocardial reperfusion through primary PCI. This outcome compares favorably with international standards and previous studies in non-diabetic populations [37].

The higher prevalence of anterior wall MI (58%) compared to inferior wall MI (42%) carries prognostic implications, as anterior wall involvement typically affects a larger territory of myocardium and is associated with poorer outcomes. However, our intervention results showed comparable improvement regardless of infarct location [38]. The improvement in left ventricular ejection fraction from admission to discharge represents a crucial finding. The shift toward higher ejection fraction categories at discharge suggests effective myocardial salvage through timely intervention. This improvement is particularly significant given that diabetic patients typically demonstrate impaired recovery of left ventricular function following MI [39, 40].

5. Conclusion

This study shows that primary PCI in diabetic patients with acute myocardial infarction yields favorable immediate outcomes, as evidenced by significant improvements in both electrocardiographic parameters and left ventricular function. The predominance of cases in middle-aged adults, particularly males, underscores the importance of aggressive preventive strategies in this demographic. Despite the complex nature of coronary artery disease in diabetic patients, timely intervention through primary PCI effectively achieves myocardial reperfusion and functional recovery. The improvement in ejection fraction from admission to discharge suggests good myocardial salvage potential, even in this high-risk population.

Compliance with ethical standards

Conflict of interest statement

The authors declare that they have no conflicts of interest.

Statement of ethical approval

The study protocol received approval from the Institutional Ethics Committee (IEC/KCPT/2023-24/121) of the tertiary care teaching hospital prior to initiation, following the principles outlined in the Declaration of Helsinki.

Statement of informed consent

Written informed consent was obtained from all participants in the study. Patient confidentiality was maintained throughout the study period.

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