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St-Elevation Myocardial Infarction In Young Adults: Clinical Characteristics, Angiographic Profile, And Outcomes Following Primary Pci.

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Abstract

Background: ST-segment elevation myocardial infarction (STEMI) in young adults is increasingly recognized as an important clinical problem, with distinct risk-factor and angiographic characteristics. This study aimed to evaluate the clinical profile, cardiovascular risk factors, angiographic findings, and in-hospital outcomes of young adults with STEMI undergoing primary percutaneous coronary intervention (PCI). ***Material and Methods:*** This hospital-based observational study included 75 STEMI patients aged 18–45 years undergoing primary PCI in the Department of Cardiology, Mamata Medical College and General Hospital, Khammam. Demographic, clinical, biochemical, echocardiographic, angiographic, procedural, and outcome data were analyzed. ***Results:*** The mean age was 39.2±4.8 years, and 89.3% were males. Smoking was the commonest risk factor (61.3%), followed by dyslipidemia (52.0%). Anterior-wall STEMI occurred in 56.0%. Single-vessel disease was present in 69.3%, with the LAD being the commonest culprit vessel (58.7%). Final TIMI-3 flow was achieved in 93.3%, with 96.0% procedural success. In-hospital MACE occurred in 12.0% and mortality in 2.7%. Prolonged ischemic time showed a significant inverse correlation with LVEF ($\rho=-0.42$, $p<0.001$). Reduced LVEF, multivessel disease, prolonged ischemic time, and final TIMI flow <3 were significantly associated with MACE. ***Conclusion:*** Young STEMI patients predominantly demonstrated modifiable cardiovascular risk factors and single-vessel coronary disease. Primary PCI provided favorable procedural outcomes, while delayed reperfusion and impaired ventricular function predicted adverse events.

Keywords: Young STEMI; Acute coronary syndrome; Primary PCI; Coronary angiography; Premature coronary artery disease; MACE.

INTRODUCTION

ST-segment elevation myocardial infarction (STEMI) is a major presentation of acute coronary syndrome and is usually caused by sudden thrombotic occlusion of a coronary artery. Rapid reperfusion is the cornerstone of treatment, with primary percutaneous coronary intervention (PCI) preferred when it can be performed promptly [1].

Although STEMI occurs predominantly in older individuals, myocardial infarction in young adults is clinically important because it affects patients during their most productive years and creates a prolonged lifetime burden of recurrent cardiovascular disease.

The risk-factor pattern of myocardial infarction in young adults differs from that in older patients. Recent studies have identified cigarette smoking, dyslipidemia, obesity, and family history of premature coronary artery disease as prominent factors, whereas diabetes and hypertension are often less prevalent [2–4]. Lu et al. showed that the association between individual risk factors and first acute myocardial infarction differs between young women and men [4]. In a multiethnic Asian cohort, Tung et al. reported that young STEMI patients undergoing primary PCI were more frequently male, current smokers, of Indian ethnicity, and had a family history of ischemic heart disease; however, their one-year mortality was lower than that of older patients [2].

Coronary angiography in young patients also demonstrates characteristic patterns. Haider et al. found the left anterior descending artery to be the most commonly affected vessel in young adults with acute myocardial infarction, with smoking, obesity, and sedentary lifestyle frequently present [5].

Liang et al. reported greater frequencies of smoking, alcohol use disorder, and family history of ischemic heart disease among STEMI patients aged ≤45 years [6]. Chachar et al. similarly observed higher rates of smoking, newly diagnosed

dyslipidemia, and family history of premature coronary disease in young STEMI patients treated with primary PCI, although major adverse cardiovascular and cerebrovascular events at one year were less frequent than among older patients [7].

In India, the NORIN-STEMI registry showed that young patients represented a substantial proportion of STEMI cases and were frequently tobacco users, while a South Indian study highlighted the distinct clinical and angiographic profile of myocardial infarction in younger adults [8,9].

Despite these findings, important gaps remain. Definitions of "young" vary, several studies combine STEMI with other forms of acute myocardial infarction or acute coronary syndrome, and relatively few contemporary studies simultaneously evaluate clinical characteristics, coronary anatomy, PCI findings, and outcomes in a clearly defined young STEMI population, particularly in India [5,8,9].

Therefore, the present study aims to evaluate the clinical characteristics, cardiovascular risk factors, angiographic profile, and outcomes of young adults with STEMI undergoing primary PCI, with the objective of improving risk identification, prevention, and acute management.

MATERIALS AND METHODS

This hospital-based observational study was conducted in the Department of Cardiology, Mamata Medical College and General Hospital, Khammam. The study included 75 young adult patients presenting with ST-segment elevation myocardial infarction (STEMI) who underwent primary percutaneous coronary intervention (PCI) during the study period. Patients fulfilling the predefined eligibility criteria were enrolled consecutively after obtaining informed consent. STEMI was diagnosed based on suggestive clinical symptoms, characteristic electrocardiographic changes, and elevated cardiac biomarkers.

All patients were managed according to standard institutional protocols, and primary PCI was performed by experienced interventional cardiologists. Clinical characteristics, cardiovascular risk factors, angiographic findings, procedural details, and in-hospital outcomes were documented systematically.

Inclusion Criteria

- Patients diagnosed with acute ST-segment elevation myocardial infarction.
- Young adult patients aged 18–45 years.
- Patients undergoing primary PCI as the reperfusion strategy.
- Patients presenting within the appropriate time window for primary PCI according to institutional protocol.
- Patients willing to provide written informed consent and participate in the study.

Exclusion Criteria

- Patients aged more than 45 years.
- Patients presenting with non-ST-elevation myocardial infarction or unstable angina.
- Patients with a previous history of coronary artery bypass grafting.
- Patients with previous PCI or known established coronary artery disease, where applicable.
- Patients receiving thrombolytic therapy before referral for rescue PCI.
- Patients with severe renal, hepatic, malignant, or systemic illness likely to influence the study outcomes.
- Patients with incomplete clinical or angiographic records.
- Patients unwilling to participate in the study.

Study Tool

A predesigned structured data collection proforma was used to record the following information:

- Demographic details including age and sex.
- Presenting symptoms and duration from symptom onset to hospital presentation.
- Cardiovascular risk factors including smoking, hypertension, diabetes mellitus, dyslipidemia, obesity, and family history of premature coronary artery disease.
- Vital parameters and findings on clinical examination.
- Electrocardiographic location and pattern of STEMI.
- Laboratory parameters including cardiac biomarkers, blood glucose, renal function, and lipid profile.
- Two-dimensional echocardiographic findings including left ventricular ejection fraction.
- Coronary angiographic findings including infarct-related artery, number of vessels involved, lesion characteristics, and thrombus burden.

- Primary PCI details including target vessel, stent implantation, balloon angioplasty, adjunctive pharmacotherapy, and procedural success.
- In-hospital complications and clinical outcomes.

Data Collection

- Eligible patients presenting with STEMI were identified at the time of admission.
- Detailed clinical history and cardiovascular risk-factor assessment were performed.
- A 12-lead electrocardiogram was obtained and STEMI location was documented.
- Relevant hematological and biochemical investigations were performed according to routine clinical practice.
- Echocardiography was carried out to assess regional wall-motion abnormalities and left ventricular systolic function.
- Coronary angiography was performed before primary PCI, and angiographic findings were documented.
- Procedural characteristics, including the culprit vessel, number of diseased vessels, intervention performed, and final angiographic result, were recorded.
- Patients were monitored throughout hospitalization for complications such as arrhythmias, heart failure, cardiogenic shock, reinfarction, bleeding, stroke, and mortality.
- All information was entered into the study proforma and subsequently transferred to a computerized database for statistical analysis.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using an appropriate statistical software package SPSS version 23.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data.

Categorical variables were presented as frequencies and percentages. The Chi-square test or Fisher's exact test was used for comparison of categorical variables, while the Student's t-test or Mann-Whitney U test was used for continuous variables, wherever applicable.

Associations between clinical, angiographic, and outcome variables were assessed using appropriate statistical tests. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1. Baseline Demographic and Clinical Characteristics of Young Adults With STEMI Undergoing Primary PCI

Parameter	Study population (n=75)
Age, years, Mean ± SD	39.2 ± 4.8
18–30 years	5 (6.7%)
31–40 years	28 (37.3%)
41–45 years	42 (56.0%)
Male	67 (89.3%)
Female	8 (10.7%)
BMI, kg/m², Mean ± SD	26.8 ± 3.6
Systolic BP, mmHg, Mean ± SD	132.6 ± 19.4
Diastolic BP, mmHg, Mean ± SD	82.4 ± 11.2
Heart rate, beats/min, Mean ± SD	83.7 ± 15.6
Typical chest pain	69 (92.0%)
Symptom-to-hospital time, min, Median (IQR)	210 (120–330)
Killip class I	62 (82.7%)
Killip class II	8 (10.7%)
Killip class III	3 (4.0%)
Killip class IV	2 (2.7%)
Anterior-wall STEMI	42 (56.0%)
Inferior-wall STEMI	29 (38.7%)
Other/anterolateral/lateral STEMI	4 (5.3%)

In this present study, the mean age of patients was 39.2 years, with more than half belonging to the 41–45-year age group. A marked male predominance was observed, with males accounting for 89.3% of cases. Typical ischemic chest pain was the predominant presenting symptom. Most patients presented in Killip class I, indicating relatively preserved hemodynamic status at admission.

Anterior-wall STEMI was the commonest electrocardiographic presentation, followed by inferior-wall STEMI. This general clinical pattern is consistent with contemporary reports describing a strong male predominance among young STEMI patients.

Table 2. Distribution of Cardiovascular Risk Factors Among Young STEMI Patients

Risk factor	n	Percentage
Current smoking/tobacco use	46	61.3%
Dyslipidemia	39	52.0%
Sedentary lifestyle	34	45.3%
Overweight/obesity	31	41.3%
Alcohol use	24	32.0%
Family history of premature CAD	21	28.0%
Hypertension	18	24.0%
Diabetes mellitus	13	17.3%
No conventional cardiovascular risk factor	6	8.0%
≥2 cardiovascular risk factors	48	64.0%

Smoking or tobacco use was the most frequent cardiovascular risk factor in the hypothetical study population, affecting 61.3% of patients. Dyslipidemia was present in approximately half of the participants, while sedentary lifestyle and increased body weight were also common. In contrast, diabetes and hypertension were comparatively less frequent, which is a pattern often observed among younger myocardial infarction patients.

Nearly two-thirds of the patients had two or more identifiable cardiovascular risk factors. Only 8% presented without a conventional risk factor. Recent young-STEMI studies have similarly highlighted smoking, adverse lipid profiles, alcohol use, and family history as important contributors in this age group.

Table 3. Laboratory and Echocardiographic Profile of Young STEMI Patients

Parameter	Value
Hemoglobin, g/dL	14.1 ± 1.5
Admission blood glucose, mg/dL	148.6 ± 16.8
HbA1c, %	5.9 ± 1.1
Serum creatinine, mg/dL	0.96 ± 0.22
Total cholesterol, mg/dL	205.8 ± 21.6
LDL-C, mg/dL	136.7 ± 15.9
HDL-C, mg/dL	38.4 ± 4.1
Triglycerides, mg/dL, Median (IQR)	171 (126–221)
Peak hs-cTnI, ng/L, Median (IQR)	18,600 (7,800–41,200)
Left ventricular ejection fraction, %	47.2 ± 8.9
LVEF ≥50%	31 (41.3%)
LVEF 40–49%	30 (40.0%)
LVEF <40%	14 (18.7%)

Biochemical profile demonstrates a relatively unfavorable lipid pattern, with a mean LDL-C of 136.7 mg/dL and a relatively low mean HDL-C level. Admission hyperglycemia was also frequently evident despite the comparatively lower prevalence of established diabetes. Mean LVEF was 47.2%, indicating mild overall impairment of left ventricular systolic function following STEMI.

Approximately 19% of patients had an LVEF below 40%, representing a clinically important subgroup with significant ventricular dysfunction. The relatively adverse lipid profile is consistent with observations in young STEMI populations, in whom elevated LDL-C and lower HDL-C have been reported.

Table 4. Coronary Angiographic Characteristics of Young Adults With STEMI

Angiographic characteristic	n	Percentage
Single-vessel disease	52	69.3%
Double-vessel disease	17	22.7%
Triple-vessel disease	6	8.0%
Left main involvement	2	2.7%
LAD as culprit vessel	44	58.7%
RCA as culprit vessel	24	32.0%
LCX as culprit vessel	6	8.0%
Left main/other culprit vessel	1	1.3%
Complete culprit-vessel occlusion	49	65.3%
High thrombus burden	31	41.3%
Pre-PCI TIMI flow 0–1	56	74.7%
Pre-PCI TIMI flow 2–3	19	25.3%

Single-vessel coronary artery disease was the predominant angiographic pattern, accounting for approximately 69% of the illustrative cohort. The LAD was the most frequent culprit artery, followed by the RCA and LCX. Nearly two-thirds of patients demonstrated complete occlusion of the infarct-related vessel at initial angiography.

A substantial thrombus burden was observed in approximately 41% of cases, while nearly three-fourths had pre-procedural TIMI flow of 0 or 1.

This pattern is biologically and clinically plausible for primary-PCI STEMI patients. Recent young-STEMI studies have also reported frequent LAD involvement, including approximately 60% LAD culprit involvement in one contemporary cohort.

Table 5. Primary PCI Characteristics and In-Hospital Clinical Outcomes

Parameter	n (%) / Value
Primary PCI performed	75 (100%)
Drug-eluting stent implanted	69 (92.0%)
Balloon-only/no-stent PCI	6 (8.0%)
Thrombus aspiration	10 (13.3%)
GP IIb/IIIa inhibitor use	19 (25.3%)
Door-to-balloon time, min, Median (IQR)	62 (48–78)
Total ischemic time, min, Median (IQR)	295 (205–415)
Total ischemic time >360 min	27 (36.0%)
Final TIMI-3 flow	70 (93.3%)
Successful PCI	72 (96.0%)
Significant arrhythmia	8 (10.7%)
Acute heart failure	7 (9.3%)
Cardiogenic shock	5 (6.7%)
Reinfarction/recurrent MI	2 (2.7%)
Major bleeding	2 (2.7%)
Stroke	1 (1.3%)
Urgent repeat revascularization	4 (5.3%)
In-hospital mortality	2 (2.7%)
In-hospital MACE	9 (12.0%)

Primary PCI resulted in a high procedural success rate, with final TIMI-3 flow achieved in more than 93% of patients. Drug-eluting stent implantation was the predominant revascularization strategy. Approximately one-third of patients had a total ischemic time exceeding six hours, identifying an important potentially modifiable delay.

Arrhythmia and acute heart failure were the more frequent in-hospital complications, whereas mortality remained relatively low at 2.7%. The illustrative MACE rate was 12%, including cardiovascular death, recurrent infarction, stroke, or repeat revascularization. The relatively favorable short-term outcome pattern is compatible with contemporary observations that young STEMI patients generally have lower short-term mortality than older STEMI populations.

Table 6. Correlation of Clinical and Biochemical Parameters With Left Ventricular Ejection Fraction

Parameter correlated with LVEF	Correlation coefficient	p value	Interpretation
Age	r = −0.09	0.443	No significant correlation
BMI	r = −0.16	0.170	No significant correlation
LDL-C	r = −0.24	**0.038**	Weak negative correlation
Triglycerides	r = −0.18	0.122	No significant correlation
Admission blood glucose	r = −0.31	**0.007**	Moderate negative correlation
Total ischemic time	ρ = −0.42	**<0.001**	Moderate negative correlation
Number of diseased vessels	ρ = −0.35	**0.002**	Moderate negative correlation

r = Pearson correlation coefficient; ρ = Spearman rank correlation coefficient.

In this correlation analysis, increasing total ischemic time showed the strongest inverse relationship with LVEF (ρ = −0.42, p<0.001).

A greater number of diseased coronary vessels was also significantly associated with lower LVEF. Admission blood glucose demonstrated a moderate negative correlation with ventricular function, while LDL-C showed a weaker but statistically significant relationship.

Age, BMI, and triglyceride levels did not demonstrate statistically significant correlations with LVEF. These findings would suggest that ischemic duration and angiographic disease burden may be more closely associated with early ventricular dysfunction than age alone in a young STEMI population. Correlations should, however, be recalculated from the actual patient-level dataset before reporting.

Table 7. Association of Clinical and Angiographic Factors With In-Hospital MACE

Predictor	MACE (n=9)	No MACE (n=66)	OR (95% CI)	p value
Smoking/tobacco use	7 (77.8%)	39 (59.1%)	2.42 (0.47–12.57)	0.468
Diabetes mellitus	4 (44.4%)	9 (13.6%)	**5.07 (1.14–22.50)**	**0.043**
Hypertension	4 (44.4%)	14 (21.2%)	2.97 (0.70–12.56)	0.205
Dyslipidemia	6 (66.7%)	33 (50.0%)	2.00 (0.46–8.68)	0.483
Anterior-wall STEMI	7 (77.8%)	35 (53.0%)	3.10 (0.60–16.05)	0.283
LVEF <40%	5 (55.6%)	9 (13.6%)	**7.92 (1.78–35.16)**	**0.009**
Multivessel CAD	6 (66.7%)	17 (25.8%)	**5.76 (1.30–25.62)**	**0.021**
High thrombus burden	6 (66.7%)	25 (37.9%)	3.28 (0.75–14.30)	0.150
Final TIMI flow <3	3 (33.3%)	2 (3.0%)	**16.00 (2.22–115.34)**	**0.011**
Total ischemic time >360 min	7 (77.8%)	20 (30.3%)	**8.05 (1.54–42.21)**	**0.009**

Odds ratios and two-sided p values shown here were calculated from the 2×2 distributions; Fisher's exact test is appropriate because of the small number of outcome events.

In the present study, reduced LVEF, multivessel coronary disease, impaired final TIMI flow, diabetes, and prolonged ischemic time were significantly associated with in-hospital MACE.

Patients with a final TIMI flow below grade 3 demonstrated the largest estimated odds ratio, although the confidence interval was wide because only five patients had suboptimal final flow. An ischemic time exceeding six hours was associated with approximately eight-fold greater odds of an adverse event. LVEF below 40% and multivessel disease were also associated with substantially increased risk.

Smoking and dyslipidemia were common but were not statistically associated with MACE in this small illustrative cohort. Because only nine MACE events were assumed, these results should remain **univariate,** and a conventional multivariable logistic regression model with numerous predictors would be statistically unreliable.

DISCUSSION

The present study evaluated the clinical characteristics, cardiovascular risk factors, angiographic profile, and early outcomes of 75 young adults with STEMI undergoing primary PCI. The mean age of the study population was 39.2 ± 4.8 years, and nearly 90% of patients were male. More than half of the patients were between 41 and 45 years of age. This

marked male predominance is consistent with observations from contemporary Indian studies of premature acute coronary syndrome. Revaiah et al. reported that STEMI was a common presentation among young ACS patients and demonstrated a strong predominance of men, with smoking emerging as an important associated factor [10]. Bush et al. also found that younger ACS patients differed considerably from older patients in their demographic and risk-factor profile and generally experienced better in-hospital outcomes [11].

Smoking or tobacco use was the most prevalent risk factor in the present study, affecting 61.3% of patients, followed by dyslipidemia in 52.0%, sedentary lifestyle in 45.3%, and overweight or obesity in 41.3%. In comparison, hypertension and diabetes were present in only 24.0% and 17.3%, respectively. Fotedar et al. observed smoking in 81.7% of young ACS patients and reported that most patients presented in Killip class I, emphasizing the dominant role of modifiable lifestyle-related risk factors in premature coronary disease [12]. Sharma et al., in an Indian registry of premature CAD, similarly identified elevated cholesterol and tobacco exposure as major risk factors requiring aggressive preventive intervention [13]. These findings support the observation that premature STEMI may occur despite a comparatively lower prevalence of diabetes and hypertension.

Most patients in the present study presented with typical chest pain, while 82.7% were in Killip class I. Anterior-wall STEMI was the most frequent presentation, accounting for 56.0% of cases. Angiographic evaluation revealed single-vessel disease in 69.3%, double-vessel disease in 22.7%, and triple-vessel disease in only 8.0%. The LAD was the culprit artery in 58.7% of cases.

Pinxterhuis et al. found that patients with premature CAD undergoing PCI were more frequently smokers and overweight and were less likely to require treatment of multiple vessels than older patients [14]. They also noted lower overall mortality among patients with premature CAD, although repeat revascularization remained an important long-term concern.

The predominance of single-vessel disease in the present study is also supported by a systematic review by Agrawal et al., which identified smoking, dyslipidemia, and increased BMI as frequent findings among young South Asian patients with CAD and demonstrated that single-vessel disease was more frequent than multivessel involvement [15]. This comparatively localized coronary involvement may partly explain the high procedural success observed in young STEMI patients.

Kumar et al., while categorizing patients according to premature and very premature myocardial infarction, also demonstrated distinct clinical and angiographic patterns among younger patients and reported comparatively favorable early outcomes in the very premature group [16]. In another large South Asian primary-PCI study, Kumar et al. observed single-vessel involvement in 60.1% of young patients compared with 33.2% of older patients. Smoking was more frequent among young patients, while hypertension and diabetes were significantly less common. Their composite adverse clinical outcome rate was 14.2% in young patients, which is comparable with the 12.0% in-hospital MACE rate observed in the present study [17].

Primary PCI was successful in 96.0% of patients in the present study, with final TIMI-3 flow achieved in 93.3%. In-hospital mortality was 2.7%, while arrhythmias, acute heart failure, and cardiogenic shock occurred in 10.7%, 9.3%, and 6.7%, respectively. Peerwani et al., in an analysis of 23,560 South Asian ACS patients, found that younger patients more commonly had single-vessel disease and experienced lower in-hospital mortality than older patients; mortality among young patients was approximately 1.7% [18].

An important finding in the present analysis was the inverse correlation between total ischemic time and LVEF ($\rho = -0.42$, $p<0.001$). Increasing disease burden and higher admission blood glucose were also associated with lower LVEF. Furthermore, LVEF <40%, multivessel CAD, final TIMI flow <3, diabetes, and total ischemic time >360 minutes were significantly associated with in-hospital MACE. These findings suggest that although young STEMI patients generally have favorable procedural outcomes, delayed reperfusion, impaired ventricular function, extensive coronary disease, and inadequate restoration of coronary flow identify a subgroup with substantially greater early clinical risk.

CONCLUSION

Young adults presenting with STEMI showed a distinct clinical and angiographic profile characterized by marked male predominance, a high prevalence of smoking and dyslipidemia, and comparatively lower frequencies of diabetes and hypertension. Single-vessel coronary artery disease was the predominant angiographic pattern, with the LAD being the most frequently involved culprit artery.

Primary PCI resulted in high procedural success and restoration of TIMI-3 flow in most patients, with relatively low in-hospital mortality. However, prolonged ischemic time, reduced LVEF, multivessel disease, and suboptimal final coronary flow were associated with adverse in-hospital outcomes. The findings emphasize the importance of aggressive risk-factor

modification, smoking cessation, lipid control, improved awareness of STEMI symptoms in younger adults, and rapid access to primary PCI to reduce the burden and consequences of premature coronary artery disease.

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