

ORIGINAL ARTICLE

Frequency of early stent thrombosis in patients presenting with STEMI Undergoing Primary Percutaneous Coronary Intervention (PPCI) at a Tertiary Care Hospital.

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ABSTRACT... **Objective:** To determine the frequency of early stent thrombosis in patients presenting with STEMI undergoing PPCI. **Study Design:** Case Series. **Setting:** Department of Cardiology at Sheikh Zayed Hospital, Rahim Yar Khan. **Period:** October 2025 to March 2026. **Methods:** The patients were selected using non-probability consecutive sampling and a total of 234 patients with an age range of 18-60 years and STEMI who underwent PPCI were included in the study. Demographic, clinical, biochemical, angiographic, and procedural characteristics were recorded. Patients were followed for 30 days after PPCI for the development of early stent thrombosis. SPSS version 23 was used for data analysis. **Results:** The mean age of the patients was 54.9 ± 9.2 years, and 78.6% were male patients. Common comorbidities were dyslipidemia (70.1%), hypertension (47.9%), and diabetes mellitus (44.9%). There were 13 (5.6%) patients with early stent thrombosis. The commonest presenting symptom was chest pain. The involvement of the culprit vessel was statistically significant ($p=0.028$) in association with early stent thrombosis, and there were no other significant associations with the demographic and clinical variables. **Conclusion:** Early stent thrombosis is still a clinically relevant complication following PPCI in STEMI patients. Strategies to minimize thrombotic complications and enhance patient outcomes may include careful procedural planning, aggressive management of risk factors, and monitoring to ensure proper post-procedural care.

Key words: CAD, Drug-Eluting Stent, Early Stent Thrombosis, PCI, STEMI.

Article Citation: Hamad M, Maqbool F, Rasheed I, Khalid R, Muneeb Ur Rehman, Rasool SA. Frequency of early stent thrombosis in patients presenting with STEMI Undergoing Primary Percutaneous Coronary Intervention (PPCI) at a Tertiary Care Hospital. Professional Med J 2026; 33(10):1954-1961. <https://doi.org/10.29309/TPMJ/2026.33.10.10779>

INTRODUCTION

The ST-elevation myocardial infarction (STEMI) is one of the most serious presentations of coronary artery disease and a major cause of morbidity and mortality globally.¹ It results from an abrupt and complete obstruction of a coronary artery, typically brought on by the rupture of an atherosclerotic plaque and the subsequent development of a thrombus.² Although significant progress has been made in the pharmacologic treatment and reperfusion strategies, STEMI remains a significant global health burden, especially in LMICs, where delays in presentation and poor access to specialist cardiac interventions further compromise outcomes.³

When compared to thrombolytic therapy, primary percutaneous coronary intervention (PPCI), the gold standard reperfusion method for STEMI, has dramatically increased survival and decreased

morbidity.⁴ Despite advancements in technology and medicine, stent thrombosis is still regarded as a serious and sometimes fatal condition.⁵ According to reports, the incidence of early stent thrombosis (ST), which occurs within 30 days of implantation, ranges from 0.5% to 1% of all modern PCI cases, and it can reach 5% in high-risk groups of STEMI patients receiving primary PCI.^{6,7} Certain registry analyses have shown that STEMI is more likely than non-ST elevation acute coronary syndrome to experience early stent thrombosis.⁸ Importantly, early stent thrombosis has a serious prognosis: death can occur in the hospital in over 20% of cases, and the incidence of recurrent myocardial infarction is above 50% in patients who develop early stent thrombosis.⁹

Early stent thrombosis can be caused by several clinical, procedural, and pharmacological factors.¹⁰

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Article received on:

04/04/2026

Accepted for publication:

08/06/2026



These include delayed presentation, sub-optimal stent deployment, dissection or residual dissection, inadequate antiplatelet therapy, diabetes mellitus, renal dysfunction, and complex lesion morphology.¹¹ Furthermore, STEMI patients are a highly susceptible population due to increased systemic inflammation and prothrombotic status at the time of PCI, which increases their susceptibility to acute thrombotic events even with the best PCI practices.¹²

Early stent thrombosis continues to be a significant issue, especially in real-world clinical practice, despite the technological improvements of the stents and the development of dual antiplatelet therapy. There are few local data on the frequency and factors associated with it in patients undergoing PPCI for STEMI. The lack of region-specific evidence limits our understanding of the actual burden of this complication and makes the development of region-specific preventive strategies difficult. The objective of the present study is to determine the incidence of early stent thrombosis in STEMI presenting patients undergoing primary percutaneous coronary intervention.

METHODS

The present case series study was descriptive and conducted in the Department of Cardiology at Sheikh Zayed Hospital during the six months from October 2025 to March 2026. The study has been approved by the Institutional Review Board (IRB) of Sheikh Zayed Medical College, Rahim Yar Khan (Reference No. 161/IRB/SZMC/SZH Dated: 08-05-2025). Before enrolling in the study, each subject provided written informed consent.

A total of 234 patients were included in the study. The sample size was determined using the OpenEpi sample size calculator, with an estimated frequency of acute stent thrombosis (5.8%), a 95% confidence level, and a desired precision of 3.0%.¹³ A non-probability consecutive sampling technique was employed for patient recruitment.

The study population consisted of all patients aged 18 to 60 years, both male and female, who had STEMI and were scheduled for primary PCI (PPCI). Patients with previous coronary stenting in the same culprit vessel and those having a known bleeding disorder

or contraindication to dual antiplatelet therapy were excluded from the study. A total of 234 patients presenting to the emergency department with a diagnosis of STEMI and fulfilling the inclusion criteria were recruited consecutively. On a predesigned proforma, demographic and clinical information such as age, gender, body mass index (BMI), diabetes mellitus, hypertension, smoking, dyslipidemia, lipid profile, and family history of coronary artery disease (CAD) were documented.

A pre-PPCI echocardiogram was performed in all enrolled patients, and LVEF (%) was documented. All the patients received 300 mg of soluble aspirin, 600 mg of clopidogrel and 70-100 units/kg of unfractionated heparin in a dose proportional to body weight before the procedure. All were treated with standard stenting procedures, with the use of post-dilation with non-compliant (NC) balloons performed in all cases. Consultant interventional cardiologists performed all PPCI procedures in accordance with the hospital's standard practice.

Procedural information was recorded, including lesion length, culprit vessels such as the left anterior descending artery (LAD), right coronary artery (RCA), or left circumflex artery (LCX), and single, double, or triple vascular disease. Furthermore, the kind of stent used, including the drug-eluting stent or plain balloon angioplasty, the length, and the diameter of the stent were also recorded.

After PPCI, each patient stayed in the hospital for 24 hours and was then followed for 30 days for the occurrence of acute stent thrombosis. Patients were evaluated for signs and symptoms of stent thrombosis (chest pain, shortness of breath, perspiration, palpitations, syncope, or sudden collapse). Operational definitions of the study were used to determine the diagnosis of stent thrombosis. All the material collected was recorded on the pre-designed proforma.

Patients had an ST-elevation myocardial infarction (STEMI) based on the electrocardiographic (ECG) criteria.¹⁴ Patients with new ST-segment elevation at the J-point in two adjacent leads ≥ 1 mm in all leads other than V2-V3 were diagnosed. The cut-off values used were >2 mm in the males over 40

years of age, >2.5 mm in males under 40 years of age, and >1.5 mm in females of all ages in leads V2-V3. Primary percutaneous coronary intervention (PPCI) was named when a percutaneous coronary intervention was conducted within twelve hours of the onset of the symptoms of STEMI.

Patients who experienced a rapid or sudden onset of typical chest pain between 24 hours to 30 days following PPCI were investigated for early stent thrombosis, which indicated acute ischemia in the distribution of the target vessel in which the stent was placed. In these patients, a coronary angiography was performed, and acute stent thrombosis was confirmed if the coronary stent was completely occluded in the stented segment with angiographic presence of thrombus.

Body mass index (BMI) was determined by dividing body weight (in kg) by body height (in meters squared). Weight was measured on a calibrated weighing scale, and height was measured on a stadiometer. Patients were classified as having hypertension if they were known to have hypertension and had been prescribed anti-hypertensives for at least the last 2 years. Patients who were known diabetics for at least 2 years and had been using either oral hypoglycemic agents or parenteral antidiabetic treatment were labelled as having diabetes mellitus. Patients who were smoking at least 10 cigarettes/day for at least the previous 2 years were considered "smokers" for this study.

Dyslipidemia was considered to be present when one or more lipid parameters were found to be abnormal in the patient in the fasting lipid profile, which was obtained after a 12-hour overnight fast. These included total cholesterol levels >200 mg/dl, LDL cholesterol levels >130 mg/dl, HDL cholesterol levels <40 mg/dl in men and <50 mg/dl in women, and triglyceride levels >150 mg/dl. A first-degree relative (parent or sibling) with a documented history of CAD before the age of 55 for men and 65 for women was considered to have a positive family history for the disease. Evidence included angina, coronary artery bypass grafting (CABG), prior myocardial infarction, and abnormal exercise tolerance tests.

Data were analyzed using SPSS version 23. The normality of quantitative variables was checked by the Shapiro-Wilk test. The quantitative variables age, BMI, lipid profile parameters, ejection fraction, lesion length, and stent dimensions were presented as mean $\pm$ standard deviation. Qualitative parameters like gender, diabetes mellitus, hypertension, smoking, dyslipidemia, family history of CAD, number of diseased vessels, culprit vessel involved, and type of stent used, as well as symptoms of acute stent thrombosis, were presented as frequencies and percentages. Stratification by age, gender, diabetes mellitus, hypertension, smoking, dyslipidemia, and family history of CAD, number of diseased vessels, culprit vessel, and type of stents was performed to evaluate the impact on the risk of stent thrombosis. The data was analyzed using a post-stratification chi-square test, and a p-value of ≤ 0.05 was taken as statistically significant.

RESULTS

There were 234 patients who presented with STEMI who underwent PPCI. The average age of the subjects was 54.9 ± 9.2 years, with a majority being male. Common comorbidities observed in the patients were hypertension, diabetes mellitus, and dyslipidemia, and more than one-third of the patients were smokers. The mean ejection fraction was moderately decreased, indicating that left ventricular systolic function is impaired in the study population. The biochemical profile also showed that there was a significant number of patients who had raised triglyceride and total cholesterol. (Table-I)

Angiographic and procedural features showed that single-vessel disease was the predominant angiographic finding, while the left anterior descending artery (LAD) was the most common culprit vessel involved. Most patients were treated with drug-eluting stents. Stent thrombosis occurred in 5.6% of the patients during early PPCI. (Table-II)

In patients with early stent thrombosis, there were no significant differences in the most common presenting symptom. The most common presenting symptoms were chest pain, sweating, and shortness of breath, respectively, whereas palpitations were less common. (Table-III)

TABLE-I

Baseline demographic, clinical, and biochemical characteristics of study participants (n = 234)

Variable	Category	Frequency (%) / Mean $\pm$ SD
Age (years)	Mean $\pm$ SD	54.9 $\pm$ 9.2
Gender	Male	184 (78.6%)
	Female	50 (21.4%)
BMI (kg/m ²)	Mean $\pm$ SD	25.5 $\pm$ 3.6
Diabetes Mellitus	Yes	105 (44.9%)
	No	129 (55.1%)
Hypertension	Yes	112 (47.9%)
	No	122 (52.1%)
Smoking	Yes	93 (39.7%)
	No	141 (60.3%)
Family History of CAD	Yes	68 (29.1%)
	No	166 (70.9%)
Ejection Fraction (%)	Mean $\pm$ SD	42.1 $\pm$ 9.1
Triglycerides (mg/dL)	Mean $\pm$ SD	191.5 $\pm$ 45.6
HDL Cholesterol (mg/dL)	Mean $\pm$ SD	39.1 $\pm$ 7.1
LDL Cholesterol (mg/dL)	Mean $\pm$ SD	129.9 $\pm$ 25.8
Total Cholesterol (mg/dL)	Mean $\pm$ SD	214.7 $\pm$ 39.3
Dyslipidemia	Present	164 (70.1%)
	Absent	70 (29.9%)

TABLE-II

Angiographic, procedural characteristics, and frequency of early stent thrombosis in patients undergoing PPCI (n = 234)

Variable	Category	Frequency (%) / Mean $\pm$ SD
Number of Diseased Vessels	Single Vessel Disease	95 (40.6%)
	Double Vessel Disease	83 (35.5%)
	Triple Vessel Disease	56 (23.9%)
Culprit Vessel	LAD	122 (52.1%)
	RCA	68 (29.1%)
	LCX	44 (18.8%)
Lesion Length (mm)	Mean $\pm$ SD	26.0 $\pm$ 6.7
Type of Stent Used	Drug Eluting Stent	224 (95.7%)
	Plain Balloon Angioplasty	10 (4.3%)
Stent Length (mm)	Mean $\pm$ SD	28.2 $\pm$ 7.0
Stent Diameter (mm)	Mean $\pm$ SD	2.9 $\pm$ 0.4
Early Stent Thrombosis	Present	13 (5.6%)
	Absent	221 (94.4%)

TABLE-III

Clinical presentation of patients with early stent thrombosis after PPCI (n = 234)

Symptom	Frequency (%)
Chest Pain	8 (3.4%)
Shortness of Breath	1 (0.4%)
Sweating	3 (1.3%)
Palpitations	1 (0.4%)

In stratified analysis, age, gender, diabetes mellitus, hypertension, smoking status, dyslipidemia, and family history of coronary artery disease did not significantly correlate with early stent thrombosis ($p > 0.05$). Diabetics and individuals without dyslipidemia had increased rates of stent thrombosis, although these differences were not statistically significant. (Table-IV)

The angiographic and procedural variables were statistically significant when analyzed for association with early stent thrombosis ($p=0.028$), with patients having right coronary artery involvement having a comparatively higher frequency of thrombosis. However, no significant association was observed between early stent thrombosis and the number of diseased vessels or the type of stent used. (Table-V)

DISCUSSION

A total of 234 patients were included, of which 62% were male and the mean age was 54.9 ± 9.2 years. The frequency of early stent thrombosis was found to be 5.6%. The study population had several comorbidities, including dyslipidemia, hypertension, and diabetes mellitus. Demographic and other clinical variables did not have statistically significant associations, except for culprit vessel involvement, which showed a significant association with early stent thrombosis.

The present study aimed at determining the incidence of early stent thrombosis in a population of STEMI patients who underwent PPCI and reported 5.6% of early stent thrombosis. The result is similar to that of Ullah et al. 2022, who reported 5.8% of STs in a Pakistani population who underwent primary PCI for STEMI.⁶ They also noted that while interventional cardiology and pharmacotherapy have progressed, early stent thrombosis continues to be a clinically important event.^{13,14}

TABLE-IV

Stratification of early stent thrombosis with respect to demographic and clinical variables (n = 234)

Variable	Category	Stent Thrombosis Absent n (%)	Stent Thrombosis Present n (%)	P-Value
Age	≤40 years	9 (90.0%)	1 (10.0%)	1.000
	>40 years	212 (94.6%)	12 (5.4%)	
Gender	Male	174 (94.6%)	10 (5.4%)	1.000
	Female	47 (94.0%)	3 (6.0%)	
Diabetes Mellitus	Yes	97 (92.4%)	8 (7.6%)	0.214
	No	124 (96.1%)	5 (3.9%)	
Hypertension	Yes	117 (95.9%)	5 (4.1%)	0.310
	No	104 (92.9%)	8 (7.1%)	
Smoking	Yes	88 (94.6%)	5 (5.4%)	0.923
	No	133 (94.3%)	8 (5.7%)	
Dyslipidemia	Yes	157 (95.7%)	7 (4.3%)	0.188
	No	64 (91.4%)	6 (8.6%)	
Family History of CAD	Yes	65 (95.6%)	3 (4.4%)	0.761
	No	156 (94.0%)	10 (6.0%)	

TABLE-V

Stratification of early stent thrombosis with respect to angiographic and procedural variables (n = 234)

Variable	Category	Stent Thrombosis Absent n (%)	Stent Thrombosis Present n (%)	P-Value
Number of Diseased Vessels	Single Vessel Disease	88 (92.6%)	7 (7.4%)	0.542
	Double Vessel Disease	80 (96.4%)	3 (3.6%)	
	Triple Vessel Disease	53 (94.6%)	3 (5.4%)	
Culprit Vessel	LAD	118 (96.7%)	4 (3.3%)	0.028
	RCA	60 (88.2%)	8 (11.8%)	
	LCX	43 (97.7%)	1 (2.3%)	
Type of Stent Used	Drug Eluting Stent	211 (94.2%)	13 (5.8%)	0.658
	Plain Balloon Angioplasty	10 (100%)	0 (0%)	

There was a noticeable male predominance among the patients in this study, with an average age of 54.9 ± 9.2 years. This finding is comparable to the one reported by Habib et al in 2026, which included a majority of patients with early stent thrombosis and a predominance of men and a middle-aged population.¹⁵ In several international registries and observational studies, the male predominance of both STEMI and PPCI patients has been consistently shown because cardiovascular risk factors are more prevalent in males.¹³

In the present study, diabetes mellitus, hypertension, smoking, and dyslipidemia were common comorbid conditions among patients. The high prevalence of metabolic risk factors in STEMI patients is highlighted as more than two-thirds had dyslipidemia in the study population. According to Mansouri et al., patients who had stent thrombosis after PPCI had greater rates of diabetes mellitus and hypertension.¹⁶ A study by Habib et al. also reported high frequencies of hypertension, dyslipidemia, and smoking in patients with early stent thrombosis.¹⁵

In the current study, the mean EF was $42.1 \pm 9.1\%$, which represents moderate left ventricular systolic dysfunction in the study population. Previous studies have demonstrated that a lower LV ejection fraction is associated with poor cardiovascular outcomes and higher thrombotic risk after PCI. A similar finding was reported by Tariq et al. (2023) with significantly reduced pre-PCI ejection fraction in patients with stent thrombosis.¹⁷

Regarding angiographic findings, the angiographic pattern of single vessel disease was the most frequent in the current study, and the most frequently involved culprit vessel was the left anterior descending artery. In a previous STEMI registry, the LAD predominated because of its large myocardial territory and hemodynamic significance, which is consistent with the study results.¹⁸ Stratification analysis found, however, that although the right coronary artery was involved in the most common vessels treated in this study, it was associated with a significantly greater rate of early stent thrombosis.

The vast majority of the participants in the current study had drug-eluting stents implanted. Due to reduced restenosis and increased long-term vascular patency, the use of drug-eluting stents has increased globally. When new-generation drug-eluting stents were used to treat STEMI patients who underwent PPCI, research conducted by the Swedish Coronary Angiography and Angioplasty Registry (SCAAR) revealed satisfactory safety findings.¹⁷

In this study, the most common presenting symptom in those who developed early stent thrombosis was chest pain. This finding is similar to what was reported in the past when recurrent ischemic chest pain is the typical clinical manifestation of acute or subacute stent thrombosis. Chest pain and hemodynamic compromise were also noted by Habib et al. as frequent symptoms of early thrombotic events following PCI.¹⁵

Demographic and clinical parameters such as age, gender, diabetes mellitus, hypertension, smoking, dyslipidaemia, and family history of CAD did not significantly predict early stent thrombosis in stratification analysis. Diabetic patients had a higher

frequency of thrombosis but this was not statistically significant. However, Tariq et al., 2019 have reported diabetes mellitus and hypertension as significant risk factors for early stent thrombosis.¹³ The discrepancy between the findings could be explained by sample size, patient characteristics, compliance with antiplatelet therapy, or the procedural techniques.

In the present study, culprit vessel involvement was associated with early stent thrombosis in a statistically significant manner, whereas the number of diseased vessels and type of stent were not significantly associated with early stent thrombosis. Several procedural predictors of stent thrombosis have been identified previously such as the stent diameter, undersizing, high thrombus burden, post procedural dissection, and inadequate TIMI flow. Kotuko et al., 2025 and Anghel et al., 2023 reported that procedural factors were the key contributors to acute and subacute stent thrombosis after PPCI.^{19,20}

Recent trials have additionally highlighted the relevance of thrombotic markers, platelet activation and coagulation derangements in the process of early stent thrombosis. Galli et al., 2024 pointed out the role played by platelet hyperreactivity and abnormalities of the coagulation pathways in those who develop coronary stent thrombosis despite following antiplatelet therapy guidelines.²¹ The findings confirm the notion of early stent thrombosis as a multifactorial event associated with patient, lesion and procedural characteristics.

The results of the present study point to the fact that early stent thrombosis still poses a significant risk in patients undergoing PPCI for STEMI despite the use of modern interventional techniques and the extensive use of drug-eluting stents. The identification of patients at increased risk of thrombotic events could help guide closer monitoring, optimize procedure strategy, and ensure strict use of dual antiplatelet therapy after PPCI. This is potentially important and may help interventional cardiologists identify patients who need close monitoring following the procedure, especially those with culprit vessel involvement like RCA lesions. Timely detection of warning signs, such as frequent chest pain, can also help with early diagnosis and treatment of stent thrombosis and

lower the risk of complications and death.

There were some limitations in the present study. The results of this study might not be transferable to the general population due to the fact that it was conducted in a single center. Due to the relatively small sample size, there was limited statistical power to investigate associations between some clinical variables and early stent thrombosis. There was no assessment of late or extremely late stent thrombosis, and the follow-up period was only 30 days. Furthermore, there was no assessment of factors that were important for the development of a post-stent thrombosis, such as adherence to medication, platelet reactivity testing, grading the thrombus burden or detailed procedural imaging modalities, such as intravascular ultrasound (IVUS) or optical coherence tomography (OCT), which could have given an additional insight into the mechanisms of stent thrombosis.

CONCLUSION

Early stent thrombosis is a clinically important complication that occurs in patients with STEMI undergoing PPCI, and occurs at a rate of 5.6% in the current study. Although most demographic and clinical variables did not show statistically significant associations, culprit vessel involvement demonstrated a significant relationship with the occurrence of stent thrombosis. The study highlights the importance of continued careful selection of patients, meticulous procedural technique, aggressive risk factor control, and strict adherence to antiplatelet therapy to reduce thrombotic complications following PPCI. Early identification and early treatment of high-risk patients can significantly enhance cardiovascular outcomes in STEMI patients and minimize post-procedural morbidity and mortality.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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3	Imran Rasheed: Methodology, drafting.
4	Rabia Khalid: Critical revisions.
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