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Original Research Article

A STUDY ON THE CLINICO-ANGIOGRAPHIC PROFILE AND COMPARISON OF IN-HOSPITAL AND SHORT-TERM OUTCOME BETWEEN EARLY AND LATE PRESENTER OF STEMI PATIENTS AFTER PRIMARY PERCUTANEOUS INTERVENTION

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Abstract

Background: Acute ST-segment elevation myocardial infarction (STEMI) requires immediate intervention to reduce myocardial damage. Primary percutaneous coronary intervention (PCI) is the treatment of choice for STEMI and is designed to restore coronary blood flow and enhance patient outcomes. This study evaluated the demographic, clinical, and procedural factors that affect primary PCI outcomes in patients with STEMI. **Materials and Methods:** This prospective observational study, conducted at the Government of Mohan Kumaramangalam Medical College and Hospital from November 2023 to October 2024, enrolled 100 STEMI patients aged ≥18 years who presented within 48 hours of symptom onset and underwent primary PCI. The data encompassed patient demographics, clinical characteristics, coronary angiography findings, and post-PCI outcomes. Statistical analyses were used to examine the associations between these factors and patient outcomes, particularly the duration of symptoms before the intervention. **Result:** The study population, predominantly male (67%) with a mean age, had comorbidities, including diabetes mellitus (51%) and systemic hypertension (41%). AWMI was the most frequent diagnosis (53%), with SVD observed in 64% of the cases. Post-PCI, 83% achieved TIMI 3 flow, indicating optimal reperfusion. Symptom duration was significantly associated with patient outcomes; patients presenting within 12 h had better outcomes, with a lower incidence of heart failure symptoms (17.6% vs. 61.2%, $p<0.0001$) and post-PCI complications than those presenting after 12 h. Diabetes mellitus and older age correlated with longer symptom duration and worse outcomes. **Conclusion:** Early intervention is crucial for patients with STEMI undergoing primary PCI, as symptom duration significantly affects clinical outcomes. Age, gender, and diabetes mellitus also influence the outcomes, underscoring the importance of prompt diagnosis and treatment.

INTRODUCTION

Coronary artery disease (CAD) is one of the significant causes of mortality worldwide, with a high incidence in low- and middle-income countries.[1] India has been reported to contribute to CAD, with over 60% of the global burden of disease, with an increasing prevalence every year.[2] An essential role in this contribution can be the genetic predisposition, adaptation to a sedentary lifestyle, and urbanization.3 Studies have reported a higher incidence of CAD in younger patients, which tends to be extensively increasing with angiographic involvement, affecting adults with different geographical and socio-demographic characteristics.[3] A heterogeneity can be seen with different characteristics of patients presenting with CAD and different angiographic profiles.[4,5] Hence, it is essential to categorize such patient characteristics that will enable a better understanding of the increasing CAD incidence in younger adults and provide effective management for such profiles with percutaneous coronary intervention PCI.

A similar study in Jammu and Kashmir evaluated patient demographic and clinical characteristics

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using a prospective PCI registry that reported single vessel disease (SVD) and multiple vessel disease (MVD) in the majority of patients. The study reports that an early PCI intervention was better in CAD patients.[6] Timely primary percutaneous coronary intervention (PPCI) has been established as more effective than fibrinolysis in decreasing mortality, re-infarction, and stroke rates.[7-10] In instances where pPCI cannot be executed within 120 minutes of STEMI diagnosis and there are no contraindications, a pharmaco-invasive (P-I) approach is recommended.[11] This approach involves administering fibrinolysis followed by rescue PCI if fibrinolysis is unsuccessful, or performing routine early PCI (including coronary angiography and PCI of the infarct-related artery if necessary) if fibrinolysis is successful.

The CAPTIM and STREAM trials found that mortality rates were similar between the pPCI and P-I strategies in patients who did not receive timely pPCI.[12,13] Nonetheless, the effectiveness of fibrinolytic therapy is optimal when administered within 2 h of symptom onset, with up to 30% of patients potentially having contraindications.[14,15] In recent decades, the use of fibrinolytic therapy in STEMI patients has decreased, and there is ongoing debate about whether delayed pPCI or a P-I strategy is preferable for patients who cannot undergo pPCI promptly. Recent observational data from France indicate that a P-I strategy may be associated with lower mortality compared to delayed PPCI.[16]

Our study aimed to assess the clinical angiographic profile and outcomes of early and late presenters of STEMI patients after post-PCI.

MATERIALS AND METHODS

This study was designed as a prospective observational investigation to assess the outcomes in patients with acute STEMI. Conducted at Govt Mohan Kumaramangalam Medical College and Hospital, this research spanned from November 2023 to October 2024 and aimed to provide insights into the effectiveness of primary PCI in this patient population.

Inclusion Criteria

Patients aged ≥ 18 years with symptoms of STEMI with a duration of less than 48 hours at the time of admission who underwent primary percutaneous coronary intervention (PCI) were included.

Exclusion Criteria

Patients younger than 18 years, with preexisting cardiomyopathy, history of prior CAD with previous coronary artery bypass grafting (CABG) or percutaneous transluminal coronary angioplasty (PTCA), and moderate to severe valvular heart disease were excluded.

A detailed patient history was obtained, including information on symptom onset and medical history. A clinical examination was performed to evaluate the severity of STEMI and other relevant health metrics. Demographic data, clinical characteristics, and procedural details were documented. Data on primary PCI outcomes, including procedural success and immediate complications, were also recorded. Patients were monitored for a specified post-procedure period to assess short-term outcomes and recovery. Follow-up included routine clinical evaluations and the recording of adverse events or secondary procedures.

Data Analysis: The collected data were analysed to identify patterns, outcomes, and associations relevant to the study objectives. Statistical methods were employed to evaluate the effectiveness of the primary PCI and other key outcomes, considering the demographic and clinical characteristics of the participants.

Ethical Considerations: The study was conducted under ethical standards, and informed consent was obtained from all the participants. Ethical approval was obtained from the institutional review board before the commencement of the study.

RESULTS

The study involved 100 acute STEMI patients with varied age distributions: 11% were under 40, 17% were 41-50, 30% were 51-60, 29% were 61-70, and 13% were over 71. Males constituted 67% of the cohort, while females accounted for 33%. Comorbidities included 51% with diabetes mellitus (DM), 41%, with systemic hypertension (SHTN), CAD (5%), and significant comorbidities (49%). Regarding smoking status, 38% were smokers and 62% were non-smokers [Table 1].

Table 1: Patient characteristics.

		Number of Patients	Percentage
Age group	<40	11	11.0%
	41-50	17	17.0%
	51-60	30	30.0%
	61-70	29	29.0%
	>71	13	13.0%
Gender	Female	33	33.0%
	Male	67	67.0%
Comorbidities	CAD	5	5.0%
	DM	51	51.0%
	SHTN	41	41.0%
	Nil	49	49.0%
Smoker	Yes	38	38.0%
	No	62	62.0%

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In diagnosing acute STEMI among patients, Anterior Wall Myocardial Infarction (AWMI) was the most prevalent, accounting for 53% of the cases. Inferior Posterior Wall Myocardial Infarction (IPWMI) accounted for 10%, Inferior Wall Myocardial Infarction (IWMI) for 19%, and a combination of IWMI with Complete Heart Block (10%). Both Anterior Wall Myocardial Infarction with Complete Heart Block (AWMI/CHB) and Left Wall Myocardial Infarction (LWMI) constituted 2% each, whereas Posterior Wall Myocardial Infarction (PWMI) made for 4%.

Clinically, 97% of the patients experienced angina, 67% had dyspnoea, and 13% reported giddiness. Symptom duration showed that 51% of the patients had symptoms lasting less than 12 hours, while 49% had symptoms lasting more than 12 hours. According to the Killip classification, 26%, 33% in class 2, 7% in class 3, and 34% of patients were in classes 1, 2, 3, and 4, respectively [Table 2].

Table 2: Clinical profile of the enrolled patients

		Number of Patients	Percentage
Diagnosis	AWMI	53	53.0%
	AWMI/CHB	2	2.0%
	IPWMI	10	10.0%
	IWMI	19	19.0%
	IWMI/CHB	10	10.0%
	LWMI	2	2.0%
	PWMI	4	4.0%
Clinical features	Angina	97	97.0%
	Giddiness	13	13.0%
	Dyspnoea	67	67.0%
Duration of symptoms	<12 hours	51	51.0%
	>12 hours	49	49.0%
KILLIP class	1	26	26.0%
	2	33	33.0%
	3	7	7.0%
	4	34	34.0%

Coronary angiography results indicated that 64% of the patients had Single Vessel Disease (SVD), 22% had Double Vessel Disease (DVD), and 14% had Triple Vessel Disease (TVD). The Left Anterior Descending (LAD) artery was the most common infarct-related artery, affecting 55% of patients, followed by the Right Coronary Artery (RCA) at 22%, Left Circumflex Artery (LCX) at 20%, and Obtuse Marginal 1 (OM1) artery at 3%.

Regarding stent deployment, 86% of patients received one stent, while 14% received two. The post-stent TIMI flow grading showed optimal TIMI grade 3 flow in 83% of patients and TIMI grade 2 flow in 17% of patients. The mortality rate was 12%, with an 88% survival rate. After PCI, 39% of the patients exhibited heart failure symptoms, particularly dyspnoea, whereas 61% showed no symptoms. No cases of dissection were reported. Post-PCI, 37% experienced dyspnoea, 8% angina, and 63% had no symptoms [Table 3].

Table 3: Angiography results and clinical characteristics of CAD patients

		Number of Patients	Percentage
CAG	DVD	22	22.0%
	SVD	64	64.0%
	TVD	14	14.0%
Infarct related artery	LAD	55	55.0%
	LCX	20	20.0%
	OM1	3	3.0%
	RCA	22	22.0%
No of stents	1	86	86.0%
	2	14	14.0%
Post-stent TIMI grading	TIMI 2 flow	17	17.0%
	TIMI 3 flow	83	83.0%
Death	No	88	88.0%
	Yes	12	12.0%
HF signs symptoms	Dyspnoea	39	39.0%
	No	61	61.0%
Dissection	No	100	100.0%
Symptoms after PCI	Dyspnoea	37	37.0%
	Angina	8	8.0%
	No	63	63.0%

Patients under 40 years of age had a higher proportion (63.6%) presenting with symptoms lasting < 12 hours than those with symptoms lasting > 12 hours (36.4%), with a statistically significant p-value of 0.036. In contrast, patients aged 61-70 years had a higher percentage (72.4%) of symptoms lasting > 12

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hours than those with symptoms lasting < 12 hours (27.6%).

Gender also showed a significant difference, with 66.7% of females presenting with symptoms lasting more than 12 hours compared to 33.3% with symptoms lasting less than 12 hours (p = 0.013). Among males, 59.7% had symptoms lasting < 12 h, while 41.8% had symptoms lasting > 12 h.

Regarding comorbidities, there was no significant difference in symptom duration between patients with comorbidities (50.6% with symptoms <12 h) and those without (54.5% with symptoms <12 h), yielding a p-value of 0.803. However, diabetes mellitus (DM) showed a significant correlation, with 62.7% of patients with DM experiencing symptoms for more than 12 h, compared to 37.3% with symptoms lasting less than 12 h (p = 0.005). In contrast, non-DM patients had a higher proportion (65.3%) of symptoms lasting < 12 h [Table 4].

Table 4: Association of demographic characteristics with duration of symptoms (<12 hours and >12 hours)

		Duration of symptoms		P value
		<12 hours	>12 hours	
Age group	<40	7 (63.6%)	4 (36.4%)	0.036
	41-50	11 (64.7%)	6 (35.3%)	
	51-60	19 (63.3%)	11 (36.7%)	
	61-70	8 (27.6%)	21 (72.4%)	
	>71	6 (46.2%)	7 (53.8%)	
Gender	Female	11 (33.3%)	22 (66.7%)	0.013
	Male	40 (59.7%)	27 (41.8%)	
Comorbidities	Yes	45 (50.6%)	44 (49.4%)	0.803
	No	6 (54.5%)	5 (45.5%)	
DM	Yes	19 (37.3%)	32 (62.7%)	0.005
	No	32 (65.3%)	17 (34.7%)	

The duration of the symptoms was significantly different across several clinical factors. AWMI was associated with a higher percentage of patients presenting with symptoms lasting > 12 h (59.2%) than those with symptoms lasting less than 12 h (47.1%) (p=0.004). Patients with IPWMI experienced a higher percentage of symptoms lasting > 12 h (18.4%) than those with symptoms lasting < 12 h (2.0%). Killip class also demonstrated a significant relationship with symptom duration. Among patients classified as Killip Class 1, 41.2% presented with symptoms lasting < 12 h, while only 10.2% presented with symptoms lasting > 12 h (p = 0.002). Killip Class 4 patients had 46.9% presenting with symptoms lasting > 12 hours compared to 21.6% with symptoms lasting < 12 hours.

Coronary angiography showed no significant association between the number of vessels affected (DVD, SVD, and TVD) and symptom duration (p=0.609). Similarly, the infarct-related arteries (LAD, LCX, OM1, RCA) did not show significant differences in symptom duration (p = 0.312). The number of stents used approached but did not reach statistical significance, with 79.6% of patients receiving one stent with symptoms lasting < 12 h compared to 92.2% of those receiving only one stent with symptoms lasting < 12 h (p = 0.070). Post-stent TIMI flow grading and mortality rates also did not show significant associations with symptom duration (p = 0.479 and p = 0.192, respectively) [Table 5].

Table 5: Association of clinical characteristics with both groups (<12 hours and >12 hours)

		Duration of symptoms		P value
		<12 hours	>12 hours	
Diagnosis	AWMI	24 (47.1%)	29 (59.2%)	0.004
	AWMI/CHB	0	2 (4.1%)	
	IPWMI	1 (2%)	9 (18.4%)	
	IWMI	13 (25.5%)	6 (12.2%)	
	IWMI/CHB	7 (13.7%)	3 (6.1%)	
	LWMI	2 (3.9%)	0	
	PWMI	4 (7.8%)	0	
KILLIP class	1	21 (41.2%)	5 (10.2%)	0.002
	2	15 (29.4%)	18 (36.7%)	
	3	4 (7.8%)	3 (6.1%)	
	4	11 (21.6%)	23 (46.9%)	
CAG	DVD	10 (19.6%)	12 (24.5%)	0.609
	SVD	35 (68.6%)	29 (59.2%)	
	TVD	6 (11.8%)	8 (16.3%)	
Infarct related artery	LAD	26 (51%)	29 (59.2%)	0.312
	LCX	9 (17.6%)	11 (22.4%)	
	OM1	1 (2%)	2 (4.1%)	
	RCA	15 (29.4%)	7 (14.3%)	
No of stents	1	47 (92.2%)	39 (79.6%)	0.07
	2	4 (7.8%)	10 (20.4%)	
Post-stent TIMI grading	TIMI 2 flow	10 (19.6%)	7 (14.3%)	0.479

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	TIMI 3 flow	41 (80.4%)	42 (85.7%)	
Death	No	47 (92.2%)	41 (83.7%)	0.192
	Yes	4 (7.8%)	8 (16.3%)	

Among individuals with symptom durations of < 12 h, only 17.6% exhibited shortness of breath, compared to 61.2% in those with symptoms lasting > 12 h. The absence of symptoms was significantly more common in the group with symptoms lasting < 12 h, with 82.4% of patients reporting no symptoms, whereas this was true for only 38.8% of patients with symptoms lasting > 12 h. The difference between the two groups was statistically significant ($p < 0.0001$). Regarding symptoms after percutaneous coronary intervention (PCI), shortness of breath was present in 17.6% of patients with symptoms lasting < 12 h, increasing to 40.8% in those with symptoms lasting > 12 h. Additionally, 16.3% of patients with symptoms lasting > 12 h experienced shortness of breath and chest pain, while none of the patients in the group with symptoms lasting < 12 h reported this combination. The absence of symptoms post-PCI was more common in patients with a shorter duration of symptoms (82.4%), compared to 42.9% in those with symptoms lasting > 12 hours ($p < 0.0001$) [Table 6].

Table 6: Association of HF symptoms in both groups

		Duration of symptoms		P value
		<12 hours	>12 hours	
HF signs symptoms	Dyspnoea	9 (17.6%)	30 (61.2%)	<0.0001
	No	42 (82.4%)	19 (38.8%)	
symptoms after PCI	Dyspnoea	9 (17.6%)	20 (40.8%)	<0.0001
	Dyspnoea, angina	0	8 (16.3%)	
	No	42 (82.4%)	21 (42.9%)	

DISCUSSION

This study reveals the key demographic, clinical, and angiographic characteristics of patients with acute ST-elevation myocardial Infarction (STEMI) and highlights significant links between symptom duration and clinical outcomes. The ideal PCI treatment window is within 12 h of STEMI onset, necessitating prompt execution.[17] However, many patients miss this critical revascularization period due to factors such as misdiagnosis, delayed transfer, or atypical symptoms. For patients unable to undergo early reperfusion, the choice between PCI and medical therapy remains debated, with limited evidence on the timing of PCI, particularly regarding long-term outcomes.

Typically, in-hospital mortality following primary PCI for STEMI ranges from 2.5% to 9.4% in Japan 18,19, 2.2% to 7.9% among unselected STEMI patients in the national registries of European Society of Cardiology member countries 20,21, and 4.6% to 6.3% in various registries in the United States.[22,23] The overall mortality rate in our study was 12%, with a higher proportion of deaths occurring in patients who presented with symptoms lasting more than 12 hours (16.3%) compared to those with symptoms lasting less than 12 hours (7.8%).

Our study included 100 patients, 11% of whom were under 40 years of age, highlighting the increasing incidence of acute coronary events in younger populations. This trend may be attributed to lifestyle factors including smoking, which was present in 38% of the cohort. The majority of patients were male (67%), which is consistent with the established understanding that STEMI is more common in males. Xue YL reported a similar study finding with a male predominance, including 70.3% males in the early PCI group and 67.0% in the late PCI group. However, the mean age of patients was above 40 years of age.[24]

A significant proportion of the patients had comorbidities, with DM being the most prevalent (51%), followed by SHTN (41%). The high prevalence of DM among patients with STEMI is of particular concern as it is associated with worse outcomes and a higher risk of complications. Comorbidities, however, did not significantly affect the duration of symptoms ($p = 0.803$), although patients with diabetes were significantly more likely to have symptoms lasting over 12 h (62.7%) than non-diabetic patients (34.7%) ($p = 0.005$). Xue YL et al. reported a higher incidence of HTN (31.9%), heart failure (31.9%), and diabetes mellitus (15.4%).[24]

Patients with AWMI often experienced prolonged symptoms, with 59.2% presenting after 12 h compared to 47.1% within 12 h ($p = 0.004$). Killip class significantly correlated with symptom duration, particularly in Killip Class 4, where 46.9% had symptoms lasting over 12 hours versus 21.6% with shorter durations ($p = 0.002$). Our findings align with those of Takagi et al., who identified a Killip class > 2 (aOR, 7.438; $p<0.001$) as a predictor of increased mortality and the need for early intervention. Their study also highlighted ejection fraction (EF) < 40% (adjusted Odds Ratio [aOR], 4.446; $p < 0.001$) and culprit lesions in the left coronary artery (LCA) (aOR, 2.940; $p < 0.001$) as independent risk factors for early PCI. Hemodynamic instability, indicated by higher Killip classification, consistently results in elevated mortality rates, even in the primary PCI era. Furthermore, mechanical complications, linked to very high in-hospital mortality, still affect approximately 1% of patients despite advances in primary PCI.[26,27]

Coronary angiography indicated that single-vessel disease (SVD) was the most common finding in 64%

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of the patients, with the Left Anterior Descending (LAD) artery being the most frequently affected (55%). This finding correlates with the higher incidence of AWMI in this cohort. Similarly, Xue et al. found that SVD was prevalent in 25.3% and DVD in 39.6% of their study population.[24] The angiography findings and stent usage showed no significant association with symptom duration, although the number of stents approached statistical significance ($p = 0.070$). Post-PCI symptoms, especially dyspnoea, were significantly more common in patients with symptoms lasting > 12 hours (40.8%) than in those with shorter durations (17.6%) ($p < 0.0001$). Conversely, the absence of post-PCI symptoms was more frequent in patients with symptom durations < 12 hours (82.4%) than in those with longer durations (42.9%) ($p < 0.0001$). Lang J et al found no significant association between early or delayed PCI and major adverse cardiovascular events.[28]

The Occluded Artery Trial found no superiority of delayed PCI (3–28 days after stable STEMI onset) over conservative drug treatment. However, this trial included only patients with persistent infarct-related artery occlusion, and only 8% received drug-eluting stents (DES), which is not representative of the current practice.[29,30] Another study reported that only 53 patients (29%) had TIMI grade 0, which was treated using second-generation DES. Further research indicates that PCI significantly benefits patients who miss early revascularization compared to medication alone. A meta-analysis of 3,560 STEMI patients showed that delayed PCI (1–26 days) extends survival by an average of 2.8 years versus conservative treatment.[31] Another meta-analysis confirmed that late reperfusion of occluded infarct-related arteries improves left ventricular systolic function and ventricular remodelling.[32]

Yang et al. found that patients with EST had significantly higher mortality rates than those with LST/VLST at in-hospital ($p = 0.004$), 30-day ($p < 0.00001$), 1-year ($p < 0.00001$), and long-term ($p = 0.04$) follow-ups. The EST group had similar in-hospital TVR/TLR rates but trended toward higher rates at 30 days and significantly higher rates at 1 year ($p = 0.002$) and the long-term ($p = 0.009$). EST patients also tended to have a higher risk of RST in both short- and long-term follow-ups, although the difference was not statistically significant. In summary, EST patients had worse clinical outcomes after PCI compared to LST/VLST patients in both short- and long-term follow-ups.[33]

CONCLUSION

Demographic and clinical factors significantly affect symptom duration in patients with STEMI, necessitating prompt intervention. Older age, female gender, and diabetes have been linked to prolonged symptoms, emphasizing the importance of early recognition in high-risk groups. Delayed symptoms were associated with AWMI and higher Killip class scores, underlining the urgent need for rapid treatment. The increased prevalence of post-PCI symptoms in patients with prolonged symptom duration suggests that early intervention reduces in-hospital complications and improves the long-term prognosis. These findings reinforce the critical need for the timely management of patients with STEMI to mitigate ischemic damage and enhance recovery.

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