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The Outcomes of Primary PCI and Importance of Clinical Characteristics of the Patient on Presentation

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ABSTRACT

Background: Acute St-segment elevation myocardial infarction (STEMI) is one of the most important cardiac emergency. Primary percutaneous intervention (PPCI) is the gold standard treatment of STEMI according to the American college of cardiology guidelines.

Objectives: The goal of this research was to determine the In-hospital outcome of primary percutaneous intervention (PPCI) at Lady Reading hospital, Peshawar and its association to the clinical characteristics of the patient on presentation.

Materials and Methods: A total of 90 patients with ST elevation Myocardial infarction (MI) and undergoing PPCI were enrolled in to this prospective observational study conducted in department of Cardiology from 23th March, 2023 to 22nd August, 2023. Enrolled patients were followed during hospital stay to determine major adverse cardiovascular events (MACES), which included outcomes of mortality, recurrent MI, need for repeat revascularization, Acute renal failure (ARF), angina, CVA, acute LVF, Cardiogenic shock and stent thrombosis.

Results: The most common adverse event was acute LVF (11.1%) followed by cardiogenic shock (7.8%) and angina (6.7%) Furthermore, logistic regression analysis results showed a strong relationship between pulse rate recorded on presentation and MACE outcomes.

Conclusion: Low rates of re-procedures and mortality during hospitalization were found, Ensuring the safety and efficacy of PPCI; higher pulse rates may be associated with a higher risk of unfavorable outcomes.

Keywords: Coronary lesion, MACE, PPCI, STEMI.

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INTRODUCTION

Cardiovascular diseases (CVD) remain the major cause of mortality and morbidity worldwide accounting for 32% of all deaths globally in 2019.[1] In 2019, CVD was the underlying cause of 9.6 million deaths among men and 8.9 million deaths among women, approximately one-third of all deaths globally. Of these deaths, 6.1 million occurred in people between the ages of 30 to 70 years. The highest number of CVD deaths occurred in China, followed by India, the Russian Federation, the United States, and Indonesia.[2] Also, majority of these deaths are preventable by screening for and eliminating known risk factors like hypertension, diabetes, dyslipidemia, cigarette smoking, physical inactivity, obesity, and poor-quality diet.[3]

Primary percutaneous coronary intervention (PPCI) is Class-I recommendation for ST elevation myocardial Infarction (STEMI) according to American Heart Association (AHA) guidelines.[4] PPCI is used to open the infarct related artery for effective restoration of perfusion of myocardium to avoid the complications, from non-perfused myocardium. The earlier, the artery is opened (shortest total ischemic time), the better are the immediate, 30 days and long-term outcome, the same is also true for shorter door to balloon time.[5]

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These outcomes are also dependent on Global Registry of Acute Coronary Events (GRACE) score and Thrombolysis in Myocardial Infarction (TIMI) score, in which clinical characteristics like age, pulse, systemic blood pressure, Killip-class of heart failure, arrhythmia, variables like troponin level, degree of ST displacement and renal function tests are considered.[6]

The SYNTAX (Synergy between percutaneous coronary Intervention with TAXUS and cardiac surgery) score is a well-defined scoring system at angiography for quantification of coronary lesions in which lesions number, lesion's location, and lesions complexity is considered[7], but it is used in elective PCI in patients who have stable ischemic heart diseases to decide between CABG and PCI based on lesion complexity.[7] The data of SYNTAX score for short-term outcome in primary PCI is limited.

Although Primary Angioplasty in Myocardial Infarction score was used in Primary Angioplasty in Myocardial Infarction (PAMI trial) to predict mortality in primary PCI,[8] In one study Syntax score was used to predict short-term outcome in primary PCI in India.[9] As Primary PCI is the ideal treatment for STEMI and is evolving in different cities of Pakistan, the primary PCI program was started in this same year in Lady Reading Hospital (LRH). This study will not only show us the efficacy and safety of primary PCI, but it will also help us identify the common MACEs of primary PCI and predict them from clinical features of the patient, enabling us to identify population at risk of MACEs, to take necessary actions before the occurrence of MACEs, to reduce morbidity and mortality associated with STEMI and Primary PCI.

MATERIALS AND METHODS

This prospective observational study was conducted in the department of cardiology of Lady Reading hospital Peshawar from March 23rd 2023 to August 22nd, 2023.The required sample size of 90, is derived using the following method for a population of 200, an expected frequency of the outcome factor of 3.3%,[9] a margin of error of +/- 3%, and a confidence level of 95% Sample size = [DEFF * N * p * (1-p)] / [(d^2 / Z^2 * (1-α/2) * (N-1) + p * (1-p)], **n=90** Ethical approval was obtained from the hospital ethical review board (Ref#No. 702/LRH/MTI-Dated 21st march 2022). All patients who presented to the emergency room with STEMI and underwent PPCI were included in this research after taking informed consent. STEMI was defined as Patients presented with chest pain along with New ST-segment elevation at the J point in at least 2 contiguous leads with the cutoff point as greater than 0.1 mV in all leads other than V2 or V3, In leads V2-V3 the cutoff point was greater than 0.2 mV in men older than 40 years old and greater than 0.25mV in men younger than 40 years old, or greater than 0.15 mV in women.[10]

Primary per cutaneous coronary intervention was defined as an urgent procedure performed to open the blocked culprit coronary artery in a patients who suffered STEMI of less than 12 hours duration, or upto 24 hours duration if there is evidence of ongoing ischemia.[11] It aims to restore blood flow to the heart and prevent further damage.

Patients who have undergone previous PCI or CABG, and patients requiring emergency CABG after coronary angiography were excluded from study. Patient age, risk factors (hypertension, diabetes, lipid profile, smoking, naswar addiction and family history of premature CAD), weight and height were documented and blood sample were sent for, blood glucose and baseline renal function tests (RFTS) to have an idea of creatinine clearance. Detail clinical examination of patients was performed quickly and vitals of blood pressure, pulse, SPO_2 and Killip class were recorded. Patients ECG were done to confirm diagnosis of MI and type of STEMI was noted. After confirmation of STEMI, 300 mg of Dispirin was given to chew and take it with water, 600 mg of clopidogrel or 180 mg of Ticagrelor was given orally to all patients. Enoxaparin dose was calculated at 1mg/kg, half of which was given IV and half subcutaneously 15 minutes after IV dose. Trans-thoracic Echocardiography was done to know about LV ejection fraction (EF), regional wall motion abnormality (RWMA) and LV clot. Angiography and PPCI was done by an operator having at-least 2 years of experience in interventional cardiology, by femoral or radial route. Drug eluting stents (DES) approved by FDA (Food and drug administration USA) as well as by DRAP (Drug regulation authority of Pakistan) was used. As per guidelines of P-PCI the culprit-only intervention was performed acutely during primary PCI in the absence of cardiogenic shock, defined as systolic Blood pressure of less than 90 mmHg for at least 30 minutes, or a patient requiring ionotropic or mechanical circulatory support to maintain blood pressure.[12] Pre-dilatation or post-dilatation after stent implantation, use of thrombuster for aspiration of clots, use of intra venous/intra coronary Tirofiban was done if needed as per recommendations. Diameters and length and number of stents were decided as per need. Time from symptoms onset to hospital, door to balloon time and total ischemic time was recorded. Number of vessels involved were documented. Number of stents along with size and company name were mentioned.

All patients were followed till discharge from hospital to determine major adverse cardiovascular outcomes.

The following were the study's primary endpoints:
A) MACES (Repeat-revascularization, angina, CVA, recurrent acute MI, stent thrombosis, acute LVF, Cardiogenic shock, acute renal failure and mortality) in-hospital stay till discharge.

For categorical variables, frequencies and percentages were computed; for continuous variables, means, and standard deviations were computed. To assess the relationships between categorical variables, chi-square tests were utilized. A p-value of 0.05 or less was regarded as significant. Univariate logistic regression was used to assess the strength of the correlations for significant associations. The adjusted odds ratios for the factors that showed relationships were calculated using multivariate logistic regression. The significance of mean differences for continuous variables between categories was evaluated using independent sample t-tests.

RESULTS

The mean age of study population was 57.03±13.48, showing a fairly wide range and mean BMI was 27.11±3.79. Two third i.e. 76.7% (n=69) of the study population was made up by males. The average BMI was 27.11, with a standard deviation of 3.79. This implies that, on average, the subjects had an overweight BMI; however, there was significant variation within the sample.

Anterior MI was the commonest type of MI in this study hence LAD was the most common culprit vessel. The average time was 91.60± 72.65 minutes, from patient's arrival to the hospital until the balloon was inflated (average door to balloon time) in the culprit artery during PCI. The average time from when the patient chest pain started until the balloon was inflated (average total ischemic time) was 300.25 minutes with a standard variation of 164.5, Right radial approach was practiced in 95.6% cases (Table 01) Hypertension was present in 48(53.3%), DM in 32 (35.6%), hyperlipidemia in 9 (10%), Smoking in 22 (24.4%), positive family history in 17 (18.9%) cases. (Table 02).

A summary of the clinical traits of the study participants is shown in Table 03. Majority of the patients were in Killip

class I (81.1%), meaning they did not had any clinical symptoms of heart failure on presentation with STEMI, Killip class II (14.4%), Killip class- III (3.3%), and severe heart failure, Killip-class IV (1.1%), were assigned to a lesser proportion of patients.

In majority of patients (95.6 %) of patients had RWMA, while only 4.4 percent showed no wall motion abnormality. Majority of patients 96.7% of patients did not have a left ventricular clot, compared to 3.3% of patients who were having LV clot.

With a standard deviation of 8.91, the average ejection fraction (EF) was 46.18%. Blood samples from the patients had a mean creatinine level of 0.96 mg/dl and a standard deviation of 0.25. The creatinine clearance was 84.97 mL/min with standard deviation of 26.98.

The average blood pressure was 124.63 mmHg for the systolic component and 78.97 mmHg for the diastolic component. The average oxygen saturation level (Spo2) was 95.64%, while the average pulse rate was 85.43 beats per minute. The average blood sugar level was 176.24 mg/dl.

It is important to understand these characteristics to evaluate the baseline health of the patients and to know any potential effects on the study's results.

Table 01. Angiographic characteristics of the enrolled patients.

Variables			N (%)
Type of MI	Posterior		3(3.3)
	Inferior		39(43.3)
	Anterior		46(51.1)
	Lateral		2(2.2)
Rhythm	Sinus		85(94.4)
	2:1 AVB		1(1.1)
	BRADY		1(1.1)
	CHB		2(2.2)
	BIGEM		1(1.1)
Access	Right Radial		86(95.6)
	Right Femoral		4(4.4)
Culprit vessel	LCX		13(14.4)
	RCA		29(32.2)
	LAD		46(51.1)
	Diagonal		2(2.2)
No of vessels	One		46(51.1)
	Two		26(28.9)
	Three		18(20.0)
Details of PCI	Pre dilatation	Yes	82(91.1)
		No	8(8.8)
	Post dilatation	Yes	50 (55.6)
		No	40 (44.4)
	Tirofiban loading dose give	Yes	47(52.2)
		No	43(47.8)
	Tirofiban maintenance dose started.	Yes	25(27.8)
		No	65(72.2)
Door to Balloon time; Mean±SD			91.60±72.65
Total ischemic time; Mean±SD			300.25±164.51
Syntax-I; Mean±SD			19.46±7.28
Syntax-II; Mean±SD			30.47±9.51

2:1 AVB: Second-degree Atrioventricular Block, BRADY: Bradyarrhythmia, CHB: Complete Heart Block, BIGEM: Bigeminy, LCX: Left Circumflex Artery, RCA: Right Coronary Artery, LAD: Left Anterior Descending Artery.

Table 02. Co-morbid/Risk factors observed among the enrolled patients.

Variables		N (%)
HTN	Yes	48(53.3)
	No	42(46.7)
DM	Yes	32(35.6)
	No	58(64.4)
Hyperlipidemia	Yes	9(10.0)
	Not known	81(90.0)
Smoking	Yes	22(24.4)
	No	68(75.6)
Addicted to snuff (Naswar)	Yes	21(23.3)
	No	69(76.7)
Family history of premature CAD	Yes	17(18.9)
	No	73(81.1)

Table 03. Clinical characteristics of the enrolled patients.

Clinical Characteristics		N (%)
Killip class	Killip class I	73(81.1)
	Killip class II	13(14.4)
	Killip class III	3(3.3)
	Killip class IV	1(1.1)
RWMA	Yes	86(95.6)
	No	4(4.4)
LV-Clot	Yes	3(3.3)
	No	87(96.7)
COVID Vaccination (4 doses)	Yes	76(84.4)
	No	12(13.3)
	NK	2(2.2)
Ejection Fraction; Mean±SD		46.18±8.91
Creatinine level (mg/dl); Mean±SD		0.96±0.25
Creatinine Clearance (mg/dl); Mean±SD		84.97±26.98
SBP (mmHg); Mean±SD		124.63±22.21
DBP (mmHg); Mean±SD		78.97±13.38
Pulse (bpm); Mean±SD		85.43±17.58
Spo2 (%); Mean±SD		95.64±2.58
Blood sugar (mg/dl); Mean±SD		176.24±71.33

NK: Not known, RWMA: Regional Wall Motion Abnormality, LV-Clot: Left Ventricle Clot, SBP: Systolic Blood Pressure (mmHg), DBP: Diastolic Blood Pressure (mmHg)

Among the MACES during hospital stay, acute LVF was observed in 11.1%, cardiogenic shock in 7.8%, Angina in 6.7%, ARF in 3.3%, and death in 1.1% cases. Fig 01

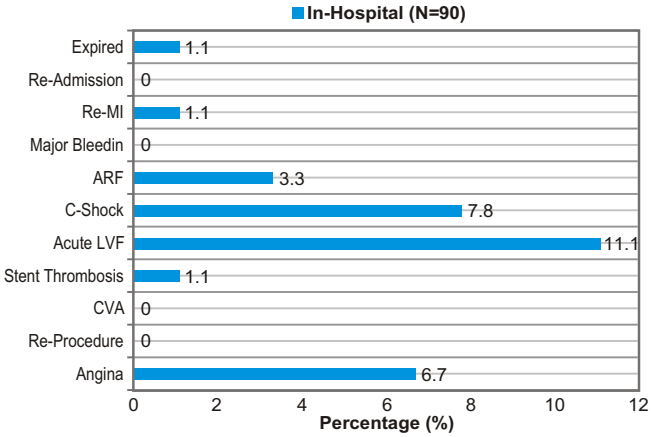


Fig 01. Frequency of in-hospital outcomes of MACEs in Primary PCI

The findings of the binary logistic regression analysis performed to assess the degree to which various factors are significantly associated with the MACE of interest are shown in Table 04. For each variable, odds ratios (OR), 95% confidence intervals (CI), and p-values are provided.

There were no significant correlations between the outcome and the existence of an LV clot, creatinine level, creatinine clearance, SBP, DBP, blood sugar, hypertension, diabetes mellitus, hyperlipidemia, smoking, and a family history of early CAD ($p > 0.05$). An odds ratio of 1.080 ($p = 0.006$) showed a statistically significant connection between pulse rate on presentation and the result. Spo2 (oxygen saturation) displayed a tenuous relationship with the result ($p = 0.075$).

Table 04. Binary logistic regression was applied to find out the strength of associations.

Variables		OR	95% CI		P-value
			Lower	Upper	
Gender	Male	1.240	0.294	5.234	0.882
	Female	Ref			
Age		1.010	0.968	1.054	0.097
BMI		1.045	0.900	1.213	0.353
Ejection Fraction		1.04	0.946	1.145	0.416
RWMA	Yes	11.547	0.598	222.845	0.105
	No	Ref			
LV Clot	Yes	0.091	0.002	4.967	0.240
	No	Ref			
Creatinine level		9.128	0.198	420.924	0.258
Creatinine Clearance		0.997	0.958	1.038	0.881
SBP		0.983	0.919	1.052	0.623
DBP		0.985	0.893	1.087	0.765
Pulse		1.08	1.022	1.14	0.006
Spo2		0.759	0.561	1.028	0.075
Blood sugar		0.997	0.986	1.008	0.535
HTN	Yes	0.941	0.299	2.965	0.917
	No	Ref			
DM	Yes	2.069	0.634	6.755	0.228
	No	Ref			
Hyperlipidemia	Yes	0.539	0.062	4.713	0.577
	Not known	Ref			
Smoking	Yes	0.684	0.192	2.432	0.557
	No	Ref			
Addicted to snuff (Naswar)	Yes	2.356	0.695	7.985	0.169
	No	Ref			
Family hx of premature CAD	Yes	0.911	0.170	4.893	0.913
	No	Ref			

DISCUSSION

This study revealed that 6 (6.7%) patients had Angina during their In-hospital stay, which is a relatively low incidence. This shows that most patients recovered from their chest pain after primary PCI. Moreover, no patients needed to have a re-procedure, signifying the initial intervention's success in opening the culprit lesion.

It is encouraging to see that there were no documented cases of cerebrovascular accidents (CVA) while the patient was in the hospital, indicating that the Primary PCI procedure did not raise the risk of this life-threatening consequences. The sample size in our study may have hampered our capacity to identify uncommon occurrences like CVA; thus, more research with larger cohorts is necessary.

In our study Stent thrombosis after PCI, occurred in 1 (1.1%) patient treated in the hospital. Which is almost the same as reported recently by Klein LW, et al.[13] However, stent thrombosis was not experienced by 98.9% of patients. The right use of antithrombotic medications and adherence to post-procedural care recommendations may have influenced this positive outcome.

Severe problems that might occur after PCI include Cardiogenic-shock and acute LVF. Cardiogenic shock (CS) occurs in 510% of patients with acute STEMI is still associated with 30-day mortality of approximately 4060% despite emergent revascularization of the culprit lesion.[14,] In our study, acute LVF occurred in 10 (11.1%) patients, and Cardiogenic-shock occurred in 7 (7.8%) patients during hospitalization. These findings highlight the significance of properly monitoring patients following PPCI and rapidly treating cardiac decompensation symptoms. However, most patients did not show Cardiogenic-shock or LVF symptoms, indicating that the PPCI intervention successfully preserved cardiac functions.

Another potential issue with PCI is acute renal failure (ARF), mostly related to using contrast material during the procedure.[15] In our study, 3 (3.3%) patients experienced ARF, showing that renal problems were uncommon. This shows that suitable preventive measures were applied during the intervention, such as adequate hydration and vigilant monitoring of renal function.

Fortunately, there were no serious bleeding incidents while the patients were hospitalized. This is significant since bleeding issues after PCI increase patient morbidity and mortality.[16] Radial access use in majority of cases is one of the reasons for reduced bleeding problem from access site.

Only 1 (1.1%) patient had a re-ST elevation myocardial infarction (Re-STEMI) while in the hospital, which is a comparatively low incidence. Further evidence that the Primary PCI intervention successfully lowered the risk of recurrent ischemia events can be found in the absence of re-admission due to cardiac problems.

The fact that 1 (1.1%) patient tragically died while hospitalized highlights the risk involved with this invasive strategy but mortality is too high with thrombolytic therapy. When estimating the total mortality rate linked to Primary PCI, it is crucial to consider elements such as patient co-morbidities and the severity of the disease.

Research by Akhtar et al. at a renowned cardiac hospital in Bangladesh indicated that MACES struck 13% of patients with STEMI within 30 days of discharge.[17] This percentage is less than the 23% MACE rate discovered in a rural Bangladesh study.[18] The 30-day MACE rates in Akhtar's study were much greater than those reported in the Netherlands (3%), India (5%), and Brazil (10%).[19,20,21] On the other hand, Akhtar's study's in-hospital MACE rate was lower than the rates reported in previous studies from China (12%) and India (8%).[20,22]

Compared to other widely-used practical scores to predict MACEs, this study provides useful insights into the applicability of the clinical characteristics in predicting MACE following PCI.

Compared to men worldwide, women had a greater incidence of MACE and mortality at 6 months after myocardial infarction.[23] In our study the odds ratio for males compared to females for the variable gender was 1.240. However, it was not statistically significant (p= 0.882), showing that gender was not significantly related to the result after primary PCI (Table III)

Regarding the clinical characteristics Our data showed no significant relationships between the outcome and gender, age, body mass index (BMI), ejection fraction (EF), the existence of an LV clot, creatinine level, creatinine clearance, blood pressure, blood sugar, hypertension, diabetes mellitus, hyperlipidemia, smoking, or family history of premature CAD. Notably, the outcome and pulse rate showed a statistically significant correlation, suggesting that higher pulse rates may be associated with a higher outcome risk. However, although statistical insignificant, regional wall motion abnormalities (RWMA) and low SpO_2 showed a potential relationship with the result.

CONCLUSION

PPCI is effective and safe procedure to treat STEMI as depicted by the Low rates of re-procedures and mortality during hospitalization, the pulse rate on presentation is an important clinical characteristic as it is significantly associated with a higher risk of unfavorable outcomes. The presence of regional wall motion abnormalities (RWMA) on Echocardiography

and low O_2-saturation on presentation showed a shaky and potential relationship with unfavorable outcomes, pointing to a possible connection. These results must be validated, and the underlying mechanisms causing these connections must be explored in more in-depth studies with larger sample sizes.

Ethical consideration

This study was approved by Institutional Review Board of Lady Reading Hospital, Peshawar, Pakistan.

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Conflict of Interest

Authors declared no conflict of interest.

REFERENCES

1. Minhas AMK, Sedhom R, D Jean E, D Shapiro M. Global burden of cardiovascular disease attributable to smoking, 19902019: an analysis of the 2019 Global Burden of Disease Study, European Journal of Preventive Cardiology, Volume 31, Issue 9, July 2024, 1123-1131. DOI: https://doi.org/10.1093/eurjpc/zwae040
2. Roth GA, Mensah GA, Fuster V. The Global Burden of Cardiovascular Diseases and Risks: A Compass for Global Action. J Am Coll Cardiol. 2020 Dec 22;76(25):2980-2981. PMID: 33309174. DOI: https://doi.org/10.1016/j.jacc.2020.11.021
3. Arafa A, Lee H-H, Eshak ES, Shirai K, Liu K, Li J, et al. Modifiable Risk Factors for Cardiovascular Disease in Korea and Japan. kcj. 2021;51(8):643-55. DOI: https://doi.org/10.4070/kcj.2021.0121
4. Lawton JS, Tamis-Holland JE, Bangalore S, Bates ER, Beckie TM, Bischoff JM, et al. 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2022;145(3):e4-e17. DOI: http://10.1161/CIR.0000000000001061. PMID: 34882436.
5. Nishio R, Ogita M, Suwa S, Nakao K, Ozaki Y, Kimura K, et al. Shorter door-to-balloon time, better long-term clinical outcomes in ST-segment elevation myocardial infarction patients: J-MINUET substudy. Journal of Cardiology. 2023;81(6):564-70. DOI: https://doi.org/10.1016/j.jjcc.2023.01.008
6. Arispe, INSR, Sol J, Gil AC. Comparison of heart, grace and TIMI scores to predict major adverse cardiac events from chest pain in a Spanish health care region. Sci Rep 13, 2023.172-80. DOI: https://doi.org/10.1038/s41598-023-44214-3
7. Vroegindewey MM, Schuurman A-S, Oemrawsingh RM, van Geuns R-J, Kardys I, Ligthart J, et al. SYNTAX score II predicts long-term mortality in patients with one-or two-vessel disease. PloS one. 2018;13(7):e0200076. DOI: https://doi.org/10.1371/journal.pone.0200076
8. Baptista SB, Farto e Abreu P, Loureiro JR, Thomas B, Nédio M, Gago S, et al. PAMI risk score for mortality prediction in acute myocardial indarction treated with primary angioplasty. Rev Port Cardiol. 2004;23(5):683-93. DOI: 2004 May;23(5):683-693. PMID: 15279453.
9. Choudhary S. Association of syntax score with short-term outcomes among acute ST-elevation myocardial infarction patients undergoing primary PCI. Indian Heart J. 2017 Apr;69 Suppl 1(Suppl 1):S20-S23. Epub 2016 Aug 24. PMID: 28400034; PMCID: PMC5388013. DOI: https://doi.org/10.1016/j.ihj.2016.08.002
10. Thygesen K, Alpert JS, Jaffe AS, Simoons ML, Chaitman BR, White HD; Joint ESC/ACCF/AHA/WHF Task Force for the Universal Definition of Myocardial Infarction; Katus HA, Lindahl B, Morrow DA, Clemmensen PM, Johanson P, et.al. Third universal definition of myocardial infarction. Circulation. 2012 Oct 16;126(16):2020-35. Epub 2012 Aug 24. PMID: 22923432. DOI: https://doi.org/10.1161/CIR.0b013e31826e1058
11. Bouisset F, Gerbaud E, Bataille V. Percutaneous Myocardial Revascularization in Late-Presenting Patients With STEMI. JACC. 2021 Sep, 78 (13) 1291-1305. DOI: https://doi.org/10.1016/j.jacc.2021.07.039
12. Uwe Zeymer, Hector Bueno, Christopher B Granger, Judith Hochman et al. Acute Cardiovascular Care Association position statement for the diagnosis and treatment of patients with acute myocardial infarction complicated by cardiogenic shock: A document of the Acute Cardiovascular Care Association of the European Society of Cardiology, European Heart Journal. Acute Cardiovascular Care, Volume 9, Issue 2, 1 March 2020, 183-197. DOI: https://doi.org/10.1177/2048872619894254
13. Klein LW, Nathan S, Maehara A, Messenger J, Mintz GS, Ali ZA, et al. SCAI Expert Consensus Statement on Management of In-Stent Restenosis and Stent Thrombosis. Journal of the Society for Cardiovascular Angiography & Interventions. 2023;2(4). DOI: https://doi.org/10.1016/j.jscai.2023.100971
14. Solangi BA, Shah JA, Kumar R, Batra MK, Ali G. Immediate in-hospital outcomes after percutaneous revascularization of acute myocardial infarction complicated by cardiogenic shock. World J Cardiol. 2023 Sep 26;15(9):439-447. DOI: https://doi.org/10.4330/wjc.v15.i9.439. PMID: 37900262; PMCID: PMC10600783.
15. Mo C, Huang Q, Li L. High-mobility group box 1 and its related receptors: potential therapeutic targets for contrast-induced acute kidney injury. Int Urol Nephrol 56,2024. 2291-2299. DOI: https://doi.org/10.1007/s11255-024-03981-2
16. Price AL, Amin AP, Rogers S, Messenger JC, Moussa ID, Miller JM, et al. Implementation of a Multidimensional Strategy to Reduce Post-PCI Bleeding Risk. Circulation: Cardiovascular Interventions. 2024;17(3):e013003. DOI: https://doi.org/10.1161/CIRCINTERVENTIONS.123.013003
17. Akhtar Z, Aleem MA, Ghosh PK. In-hospital and 30-day major adverse cardiac events in patients referred for ST-segment elevation myocardial infarction in Dhaka, Bangladesh. BMC Cardiovasc Disord 2021, 85. DOI: https://doi.org/10.1186/s12872-021-01896-9

18. Kim D-Y, Wala Z, Islam S, Islam R, Ahn M. Clinical characteristics and outcomes of ST-segment elevation myocardial infarction in a low income setting in rural Bangladesh. IJC Heart & Vasculature. 2019;23:1003-76. DOI: https://doi.org/10.1016/j.ijcha.2019.100376
19. Vos NS, Amoroso G, Vink MA, Maarse M, Adams R, Herrman J, et al. Prehospital Prasugrel Versus Ticagrelor in Real-World Patients With ST-Elevation Myocardial Infarction Referred for Primary PCI: Procedural and 30-Day Outcomes. The Journal of Invasive Cardiology. 2018;30(12):431-6.PMID: 30318484.
20. Umapathy S, Yadav R, Goswami KC, Karthikeyan G, Parakh N. Prognostic significance of fragmented QRS in patients with ST-elevation myocardial infarction undergoing revascularization. Indian Heart Journal. 2018;70:S126-S32. DOI: https://doi.org/10.1016/j.ihj.2018.07.014
21. Berwanger O, Santucci EV, de Barros e Silva PGM. Effect of Loading Dose of Atorvastatin Prior to Planned Percutaneous Coronary Intervention on Major Adverse Cardiovascular Events in Acute Coronary Syndrome: The SECURE-PCI Randomized Clinical Trial. JAMA. 2018;319(13):1331-1340. DOI: https://doi.org/10.1001/jama.2018.2444
22. Liu R, Liu J, Yang J, Gao Z, Zhao X, Chen J, et al. Association of thrombocytopenia with in-hospital outcome in patients with acute ST-segment elevated myocardial infarction. Platelets. 2019;30(7):844-53. DOI: https://doi.org/10.1080/09537104.2018.1529298
23. Sun Y, Feng L, Li X, Gao R, Wu Y. The sex difference in 6-month MACEs and its explaining variables in acute myocardial infarction survivors: Data from CPACS-3 study. International Journal of Cardiology. 2020;311:1-6. DOI: https://doi.org/10.1016/j.ijcard.2020.03.043

DATA SHARING STATEMENT: The data that support the findings of this study are available on request from the corresponding author. The data is not publicly available due to privacy or ethical restrictions.

AUTHORS' CONTRIBUTION

The following authors fullfill authorship criteria as per ICMJE guidelines;

Khan SU, Shahzad H:	Substantial contribution to conception and design, drafting the manuscript, final approval, agreed to be accountable for all the work.
Khan SB:	Substantial contribution to conception and design, data acquisition, drafting the manuscript, final approval, agreed to be accountable for all the work.
Rahmat S:	Analysis and interpretation of data, drafting the manuscript, final approval, agreed to be accountable for all the work.
Khan I:	Analysis and interpretation of data, critical revision,final approval, agreed to be accountable for all the work.

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