Original Article

Evaluation of Risk Factors Associated With Mortality in Patients Undergoing Primary PCI: A Retrospective Cohort Study

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ABSTRACT

Background: This study investigates the prognosis and complications in patients who underwent primary percutaneous coronary intervention (PCI) at Rasul Akram Hospital between 2020 and 2021. The primary objective is to improve care quality for myocardial infarction (MI) patients post-PCI by identifying and analyzing prognostic factors. Given MI's significant impact on mortality in industrialized and developing nations, recognizing and managing risk factors effectively can reduce disease burden.

Methods: A retrospective cohort design was employed. Patients were selected based on predefined inclusion and exclusion criteria. Demographic, clinical, and laboratory data and clinical outcomes were extracted from medical records and analyzed using SPSS software.

Results: Several factors influenced patient prognosis, including age, sex, prior heart disease, hypertension, diabetes, and hyperlipidemia. Those with a history of cardiac conditions or metabolic risk factors exhibited worse outcomes. The study also highlighted that timely PCI intervention and optimized risk factor management could enhance prognosis.

Conclusions: Early identification of high-risk patients and prompt, effective treatment are critical. Public and patient education on MI symptoms and the urgency of seeking immediate medical care may reduce treatment delays and improve outcomes. ***(Iranian Heart Journal 2025; 26(3): 6-14)***

KEYWORDS: Myocardial Infarction, Percutaneous coronary intervention, Mortality, Complication

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The pathological diagnosis of myocardial infarction (MI) requires evidence of myocardial cell death due to ischemia. Characteristic findings include coagulation necrosis and contraction band necrosis, often with patchy zones of myocyte lysis at the infarct margins. [1, 2] During the acute phase of MI, myocytes in the affected region die, followed by inflammation, clearance of necrotic debris, tissue repair, and eventual scar formation. [3] The clinical diagnosis of MI relies on symptoms suggesting myocardial ischemia, supported by confirmation of necrosis

through biochemical markers, ECG, or imaging techniques. The sensitivity and specificity of these diagnostic methods vary.[4–7] Professional cardiology societies have established unified criteria for MI diagnosis.[8, 9] Recent updates to these criteria, including the adoption of more sensitive biomarkers and revised MI definitions, have improved clinical care, epidemiological tracking, public health policy, and research.[10, 11]
Current guidelines categorize patients with new or worsening ischemic symptoms under acute coronary syndrome, which encompasses unstable angina, non-ST-elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI). The 12-lead ECG remains the primary diagnostic tool for suspected acute coronary syndrome, distinguishing between ST-segment elevation and non-ST-segment elevation presentations.[12, 13]
This study primarily focuses on conducting problem-oriented research to identify and better understand factors influencing treatment outcomes in patients. Utilizing data collected from Rasul Akram Hospital between 2020 and 2021, the research aims to provide a comprehensive analysis of how various demographic, clinical, and laboratory factors may affect patient prognosis. This investigation holds substantial importance not only from scientific and clinical perspectives but also for its broader implications in community health and healthcare system planning.

METHODS

Study Design

This study was a retrospective analysis aimed at investigating the prognosis and complications in patients with STEMI undergoing primary percutaneous coronary intervention (PCI). The study population comprised patients referred to and hospitalized at Hazrat Rasoul Akram Hospital in Tehran. The research sample included individuals diagnosed with STEMI who underwent primary PCI during the years 2020 to 2021. Sampling was conducted using a convenience sampling method, facilitating easy access to participants.

Inclusion and Exclusion Criteria

Inclusion criteria encompassed patients with STEMI, those who were candidates for PCI, individuals with complete clinical data, and those who provided informed consent to participate in the study. Exclusion criteria included patients with underlying diseases, individuals who had previously undergone cardiac surgery, those with incomplete clinical data, and patients who did not consent to participate in the study.

Data Collection

The data collection tools used in this study included a pre-designed checklist. This checklist comprised demographic questions, patients' medical histories and clinical statuses, examination findings at admission and during hospitalization, as well as post-primary PCI outcomes. Data were collected according to these criteria. All individuals aged 18 and older who were diagnosed with STEMI participated in the study. Additionally, clinical and laboratory data, along with surgical results, were extracted and recorded based on the information documented in the patient records.

Ethical Considerations

Necessary permissions to access files and available information were obtained from the hospital management. The required information was gathered from patient checklists and archived patient records. All patient information remained confidential with the physician, and no further ethical considerations were deemed necessary.

Statistical Analysis

For comparison of quantitative variables between groups, Student's *t*-test was used,

while qualitative variables were compared using the Chi-square test. A *P*-value threshold of 0.05 was established for statistical significance. Results are presented as mean ± standard deviation (SD) for continuous variables and as absolute frequencies (percentages) for categorical variables. All analyses were performed using SPSS version 23 (SPSS Inc., Chicago, IL).

RESULTS

Demographic and descriptive information of the studied patients

Table 1 presents demographic and clinical comparisons between deceased and surviving patients. The deceased group (13 patients) showed a mean age of 73.54 ± 8.647 years, significantly higher than survivors (349 patients, 60.39 ± 11.058 years; $P < 0.001$). Regarding anthropometric measures, deceased patients had lower mean weight (71.63 kg vs. 78.01 kg) and height (165.88 cm vs. 169.25 cm) than survivors, though these differences were less pronounced than the age disparity.

The analysis further compared several clinical parameters by mortality status, including length of hospitalization, heart rate parameters (minimum and maximum values), and blood pressure measurements (minimum and maximum systolic and diastolic values). These comprehensive comparisons provide insights into potential prognostic factors associated with patient outcomes.

Deceased patients had a shorter mean hospitalization duration (2.32 ± 2.34 d) than survivors (3.83 ± 2.43 d). Significant differences were observed in cardiovascular parameters, with deceased patients showing lower minimum heart rates (52.4 vs. 66.27, $P = 0.008$). Furthermore, both systolic and diastolic blood pressure measurements were consistently lower in deceased patients, reflecting distinct physiological profiles between the groups.

Table 1. Demographic information related to the studied patients

	Mortality	N	Mean	SD	*P*-value
Age	Yes	13	73.54	8.647	<.001*
	No	349	60.39	11.058	
Weight	Yes	8	71.63	6.696	0.232
	No	349	78.01	15.033	
Height	Yes	8	165.88	4.016	0.334
	No	347	169.25	9.856	
Hospitalization days	Yes	13	2.3238	2.34238	0.029
	No	347	3.83	2.42754	
Minimum heart rate	Yes	5	52.4	15.662	0.008*
	No	350	66.27	11.519	
Maximum heart rate	Yes	6	83.5	27.603	0.505
	No	351	91.6	16.14	
Minimum systolic blood pressure	Yes	5	93	24.454	0.357
	No	350	100.47	17.876	
Minimum diastolic blood pressure	Yes	4	62.5	9.574	0.674
	No	349	65.01	11.88	
Maximum systolic blood pressure	Yes	5	129.2	25.607	0.201
	No	350	140.3	19.164	
Maximum diastolic blood pressure	Yes	5	74.4	22.667	0.142
	No	348	83.2	13.106	

Table 2. Comparison of medication history among the studied patients based on mortality status

		Mortality				
		No		Yes		
Medication History		N	Frequency percentage	N	Frequency percentage	*P*-value
Antiplatelets	Yes	92	26	5	38	0.346
	No	257	74	8	62	
Statins	Yes	69	20	3	23	0.727
	No	281	80	10	77	
Beta-blockers	Yes	48	14	6	46	0.006
	No	302	86	7	54	
Renin-angiotensin-aldosterone system inhibitors	Yes	75	21	2	15	1
	No	275	79	11	85	
Calcium channel blockers	Yes	8	5	0	0	1
	No	139	95	7	100	
Diuretics	Yes	6	4	1	14	0.283
	No	141	96	6	86	
Proton pump inhibitors	Yes	22	6	1	8	0.582
	No	325	94	12	92	
Antiarrhythmics	Yes	0	0	0	0	-------
	No	147	100	7	100	
Anticoagulants	Yes	0	0	0	0	-------
	No	147	100	7	100	
Nitrates	Yes	5	3	0	0	1
	No	142	97	7	100	
Disease History						
Family history	Yes	138	40.5	1	8.3	0.032
	No	203	59.5	11	91.7	
Diabetes mellitus	Yes	104	29.7	8	61.5	0.024
	No	246	70.3	5	38.5	
Hyperlipidemia	No	318	91.6	12	100	1
	Controlled	24	6.9	0	0	
	Uncontrolled	5	1.4	0	0	
Hypertension	No	224	64.4	8	61.5	0.548
	Controlled	94	27	5	38.5	
	Uncontrolled	30	8.6	0	0	

Medication and disease history of the studied patients

Medication analysis revealed differential usage patterns between groups. Antiplatelet agents were used by 74% of survivors compared to 62% of deceased patients, while statin use was similar (80% vs. 77%, respectively). Beta-blocker usage showed significant variation (86% survivors vs. 54% deceased; *P* = 0.006). Notably, all survivors used calcium channel blockers and anticoagulants, whereas no deceased patients received these medications. The use of renin-angiotensin-aldosterone system (RAAS) inhibitors did not differ significantly between groups. Both cohorts used diuretics and proton pump inhibitors (PPIs), with no significant overall difference in medication profiles ($P > 0.05$).

Comorbidity analysis demonstrated significant differences in several conditions. Diabetes mellitus prevalence was higher among survivors (70.3% vs. 38.5%; *P* = 0.024). While hyperlipidemia was absent in all deceased patients, it was present in 8.4% of survivors (nonsignificant difference). Hypertension prevalence showed no significant variation (*P* = 0.548). Notably, 100% of deceased patients reported no substance abuse history. Family history of cardiovascular disease differed significantly

(40.5% survivors vs. 91.7% deceased; P = 0.032) (Table 2).

Mortality-associated clinical complications and procedural characteristics

Table 3 presents data on mortality, and Table 3 demonstrates significant differences in clinical outcomes between surviving and deceased patients. Agitation/restlessness was absent in 88% of survivors compared to only 33.3% of deceased patients (P = 0.003). Emergency department visits were not required for 77% of survivors versus 16.7% of deceased patients (P = 0.004). Heart failure occurrence showed a striking disparity, with 91.2% of survivors and 33.3% of deceased patients remaining unaffected ($P = 0.001$).

Procedural data revealed distinct access site preferences: radial access was utilized in 53% of survivors but only 8.3% of deceased patients, while femoral access predominated in deceased patients (91.7% vs. 47% in survivors). Medication continuation patterns showed no significant intergroup difference ($P > 0.05$).

The analysis revealed distinct patterns in cardiac complications between groups. Tachycardia incidence showed no significant difference, occurring in 12.3% (43/349) of survivors versus 9.1% (1/11) of deceased patients. In contrast, bradycardia demonstrated a marked disparity, affecting 6.9% (24/349) of survivors compared to 58.3% (7/12) of deceased patients ($P < 0.001$).

Stroke occurrence was rare in both groups, though slightly more frequent among deceased patients (7.7% vs. 0.6% in survivors). A striking difference emerged in resuscitation requirements: while 90.9% of survivors never needed cardiopulmonary resuscitation (CPR) or cardiac shock treatment, all deceased patients required CPR. These findings demonstrate statistically significant associations between mortality status and specific clinical events.

Table 3. Comparison of complications in the studied patients based on mortality status

		Mortality				
		No		Yes		*P*-value
		N	Frequency Percentage	N	Frequency Percentage	
Agitation and restlessness	Yes	40	12	4	66.7	0.003
	No	294	88	2	33.3	
Need for emergency visits	Yes	77	23	5	83.3	0.004
	No	258	77	1	16.7	
Heart failure	Yes	31	8.8	8	66.7	0.001
	No	320	91.2	4	33.3	
Mechanical complications	No	350	99.7	12	100	1
	PMR	0	0	0	0	
	VSR	0	0	0	0	
	FWR	0	0	0	0	
	Other	1	0.3	0	0	
Access site	Radial Access Site	185	53	1	8.3	0.002
	Femoral Access Site	164	47	11	91.7	
Continuation of medical treatment	Yes	167	47.7	3	33.3	0.508
	No	183	52.3	6	66.7	
Staging during the same admission	Yes	49	14	0	0	0.616
	No	301	86	9	100	
Staging during the subsequent admission	Yes	110	31.4	3	33.3	1
	No	240	68.6	6	66.7	
Referral for surgery	Yes	13	3.7	0	0	1
	No	337	96.3	9	100	
Tachycardia	Yes	43	12.3	1	9.1	0.747

	No	306	87.7	10	90.9	
Bradycardia	Yes	24	6.9	7	58.3	< 0.001
	No	326	93.1	5	41.7	
Cardiogenic shock and CPR	Yes	32	9.1	13	100	< 0.001
	No	318	90.9	0	0	
Incidence of stroke	No	349	99.4	12	92.3	0.039
	Before starting angiography	0	0	0	0	
	On the angiography table	0	0	0	0	
	In CCU	2	0.6	0	0	
	After CCU	0	0	1	7.7	

Table 4. Logistic regression analysis for predictors related to mortality

Variables	OR	*P*-value	95% CI	
			Down	UP
(Constant)				
Continuation of medical treatment (1)	1.719	0.39	.494	5.982
Referral for surgery (1)	1.66	0.48	0.51	3.42
Agitation and restlessness (1)	.182	.077	.027	1.201
Need for emergency visits (1)	.161	.143	.014	1.850
Heart failure (1)	.363	.278	.058	2.265
Bradycardia	1.42	0.52	.53	6.25
Bradycardia (1)	1.66	0.48	0.51	2.21
Bradycardia (2)	.182	0.02	0.027	1.201
Bradycardia (3)	.161	0.14	0.014	1.850
Bradycardia (4)	.363	0.45	0.03	1.98
Bradycardia (5)	1.719	0.39	.494	1.36
Bradycardia (6)	1.04	0.48	0.51	2.81
Tachycardia	1.66	0.48	0.51	3.42
Tachycardia (1)	.182	0.02	0.01	1.201
Tachycardia (2)	.161	0.14	0.08	1.850
Tachycardia (3)	.363	0.45	0.03	1.98
Tachycardia (4)	1.719	0.39	.494	1.36
Tachycardia (5)	1.01	0.48	0.51	2.81
Tachycardia (6)	1.04	0.13	6.42	0.11
Cardiogenic shock and CPR (1)	1.05	0.98	1.10	0.58
Mechanical complications (1)	0.47	0.30	0.73	0.37
Access site	2.27	0.57	2.23	0.32
Continuation of medical treatment	2.27	0.64	8.05	0.20

Logistic regression analysis

The variables examined in relation to patient mortality are presented in the table below. Among the factors analyzed, only bradycardia was found to be statistically significant ($P = 0.02$), while no significant relationships were observed for the other factors ($P > 0.05$) (Table 4).

DISCUSSION

Our study investigated the characteristics of patients receiving PCI treatment for STEMI. We observed a diverse patient population, with a significantly higher prevalence of STEMI in men than in women (85.2% male). This finding aligns with existing literature, indicating a greater susceptibility to STEMI in men. Notably, the majority of patients (90.4%) were married, which may imply a role of family support in managing heart disease. While social support was not directly assessed in this study, its importance in patient recovery has been well-documented. [14]

The age range in our study spanned from 22 to 93 years, with an average of 60.93 years, similar to observations made by Gharacholou et al. [15] and Stenestrand et al., [16,] indicating a

broad age spectrum for STEMI patients undergoing PCI treatment. Notably, the highest frequency of STEMI was found in individuals with freelance jobs and high school diplomas. Our findings, which focus on patient demographics, provide valuable insights into the patient population beyond the clinical outcomes often emphasized in previous studies. This information can help guide the development of targeted preventive strategies and optimize healthcare delivery across various demographic groups.

Our study's demographic findings, such as gender distribution, marital status, occupation, and educational levels of patients, highlight the diversity within the STEMI patient population receiving PCI treatment. This diversity reflects the complex interplay of individual and social factors that can impact disease progression and treatment outcomes. It emphasizes the importance of considering these factors when developing interventional and supportive strategies.

The high proportion of men and married individuals in our study draws attention to the potential influence of cultural and social factors on healthcare access and perceptions of illness.

Variations in occupation and educational levels can affect lifestyle choices, access to health information, and health management capabilities. These factors emphasize the importance of adopting a comprehensive and personalized approach in therapeutic interventions for STEMI patients to address their unique needs based on demographic characteristics and socioeconomic backgrounds. [17]

The analysis of symptoms, medical history, and social habits in STEMI patients undergoing PCI treatment highlights the significance of a multidimensional approach to patient care and management. Chest pain, being the most common initial symptom, remains a critical indicator requiring immediate medical attention. Pre-existing medical conditions, particularly cardiac and non-cardiac diseases, significantly influence treatment outcomes, emphasizing the need for a thorough patient evaluation before invasive procedures.

While smoking and substance use were not directly linked to mortality in this study, their impact on overall health and cardiovascular risk warrants consideration in the development of preventive strategies. By addressing these factors and tailoring treatment plans to individual patient needs, healthcare providers can improve outcomes and reduce the burden of STEMI across diverse patient populations.

Our study revealed that most patients exhibited a left ventricular ejection fraction (LVEF) ranging from 30% to 45%, which was the most common range observed. Only a small number of patients had a thrombus in the LV, and the majority presented with mild valvular heart disease. Pericardial effusion was also noted in a few patients.

These findings are consistent with a study conducted by Vakili et al., [18] which demonstrated an association between an LVEF below 50% and a higher incidence of in-hospital complications. Furthermore, this study found that a reduced LVEF significantly increases the risk of mortality following primary PCI.

When interpreting mortality results, it's essential to consider that some patients presented with more acute and severe conditions, leading to earlier deaths. On the other hand, longer hospital stays may suggest better recovery chances due to more comprehensive care and complication management.

The association between higher heart rates, blood pressure, and mortality in deceased patients could indicate greater physiological stress or more severe disease states. Nonetheless, differentiating between a high heart rate as a compensatory response to heart failure and high blood pressure

reflecting increased vascular resistance is crucial.
These findings emphasize the importance of rapid and accurate patient assessment upon admission, along with appropriate management strategies to minimize mortality risk. By improving treatment protocols and raising physician awareness of high-risk patient needs, earlier and more effective interventions can be implemented, ultimately leading to better patient outcomes.
A comparative analysis of tachycardia and bradycardia incidence among patients revealed a significantly higher mortality risk in those with bradycardia ($P < 0.001$). Bradycardia was observed in 6.9% of surviving patients and 58.3% of non-survivors. Conversely, tachycardia did not significantly impact mortality, with 12.3% of surviving patients and 9.1% of deceased patients experiencing tachycardia.
Several factors may contribute to these results. Bradycardia could signal more severe damage to the heart's conduction system and can also be associated with conditions like increased intracranial pressure, which may result from neurological events and potentially increase mortality risk. [19] In contrast, tachycardia can occur for various reasons and does not necessarily indicate a critical or urgent medical condition. [20]
Comparing our findings with other research reveals that bradycardia and tachycardia are considered predictors of patient outcomes in cases of STEMI. Studies have also shown that bradycardia may signify more severe cardiac damage or other complex medical conditions, necessitating immediate and thorough interventions. Consequently, these findings emphasize the significance of monitoring for bradycardia, as it can serve as a substantial risk factor for mortality.

CONCLUSIONS

In this study, we investigated various factors influencing outcomes in patients with STEMI undergoing PCI treatment, including demographics, symptoms, medical history, social habits, and treatment results. Our analysis demonstrated the predictive value of demographic factors, such as age, gender, marital status, number of children, employment status, and education level, on treatment outcomes. In addition, we found that factors like the severity of valvular heart diseases, the presence of pericardial effusion, and LVEF significantly affect treatment outcomes.
Comparisons with other studies emphasize the need for a comprehensive approach to STEMI management. Our findings on the impact of LVEF and valvular heart disease highlight the importance of diligent symptom management and rapid identification of risk factors. Moreover, the emphasis on administering emergency medications and preventing severe complications, like stroke and cardiogenic shock, can contribute to reducing mortality. This research stresses the significance of accurate patient assessments, accounting for all relevant factors to tailor individualized treatment strategies, potentially leading to improved outcomes compared to generic treatment plans.
By informing the development of enhanced treatment strategies and encouraging patient education, this research can contribute to a significant reduction in cardiovascular disease mortality.

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