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Original Article

Risk Factors for In-Hospital Mortality in ST-Elevation Myocardial Infarction

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ABSTRACT

Objective: In this study, we aimed to evaluate the in-hospital mortality indicators in patients presenting with ST-elevation myocardial infarction (STEMI) to our clinic and undergoing primary angioplasty.

Methods: Four hundred patients presenting to our clinic with a diagnosis of STEMI and undergoing primary angioplasty were included in the study. Patient files were retrospectively reviewed. The relationship between in-hospital mortality and the development of complications after primary angioplasty and patients' demographic, clinical, and laboratory characteristics were evaluated.

Results: In the patient group included in the study, advanced age (≥65), diabetes mellitus, hypertension, and female gender were found to increase in-hospital mortality significantly. A significant increase in in-hospital mortality was observed in patients with left ventricular ejection fraction (LV EF) below 40%. Elevated baseline creatinine and troponin levels, high heart rate, presence of shock, and hypotension significantly increased in-hospital mortality in patients.

Conclusion: In our study, we found that the risk factors, clinical and laboratory characteristics, and complications developed in patients presenting with acute STEMI are directly related to patient mortality. Identifying these mortality predictors is essential in determining patient risk, guiding treatment, and follow-up.

Keywords: Myocardial infarction, in-hospital mortality, indicator

INTRODUCTION

Coronary heart disease ranks first in both mortality and morbidity in developed countries as well as in our country.[1] ST-elevation myocardial infarction (STEMI) is a significant cause of mortality with its complications. Among the major complications of STEMI are heart failure, cardiac rupture (free wall, ventricular septal, papillary muscle), arrhythmias, post-infarction angina, right ventricle failure, pericarditis, and left ventricular thrombi leading to embolism.[2,3]

Early revascularization in STEMI significantly reduce the development of complications.[4,5] There is a relationship between the medical and demographic characteristics of patients and the development of complications. For example, in acute anterior STEMI, the prognosis is related to the site of the occlusion and the extent of myocardial necrosis. Similarly, there is a relationship between patient age, gender, accompanying other diseases, number and location of occluded coronary arteries, and the development of complications. Although there are enough studies in the literature trying to establish this relationship, there is a need for new indicators.[6-9]

In our study, we aimed to reveal the affiliation between the classical risk factors and in-hospital complication development-mortality in patients undergoing primary angioplasty due to STEMI.

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MATERIAL AND METHODS

Four hundred patients, 340 males and 60 females, diagnosed with STEMI and having undergone primary angioplasty were involved in our study. Patient files were retrospectively reviewed. In-hospital mortality and the development of complications after primary angioplasty were recorded, and the relationship between the demographic and clinical features of the patients were evaluated. The evaluation used catheter laboratory records, patient files, and discharge records. All patients underwent coronary angiography via transfemoral access. The study was approved by the Ethics Committee of Atatürk University Faculty of Medicine (approval no.: 2, date: February 11, 2011). Since it was a retrospective study, patients did not provide informed consent.

On behalf of the diagnosis of STEMI, we used the criteria of ST-segment elevation in at least 2 consecutive derivations (≥2 mm in chest derivations, ≥ 1mm in limb derivations) or new-onset left bundle branch block, the existence of ischemic-type chest pain lasting more than 30 minutes, and an increase in serum troponin levels.[10] Patients' demographic characteristics, presence of coronary artery disease risk factors (age, family history, gender, smoking, hyperlipidemia, diabetes mellitus (DM), hypertension (HT), and clinical characteristics were determined in terms of hemodynamic parameters, cardiac enzyme, and troponin levels, time of myocardial infarction (<6 hours, ≥6 hours) and localization of infarction, revascularized vessel, ejection fraction, and multi-vessel disease. Patients with at least 50% stenosis in other coronary arteries except the responsible lesion were included. At the same time, mechanical and non-mechanical complications were determined in terms of in-hospital complications and mortality; clinical heart failure and mechanical and non-mechanical complications were determined. Figure 1 shows the complication number according to groups. All patients included in the study were given treatments according to guidelines.[10]

MAIN POINTS

- In our study, we aimed to investigate the factors that affect in-hospital mortality in ST-elevation myocardial infarction.
- Male gender, presence of diabetes mellitus, hypertension, cardiogenic shock, hypotension, elevated baseline heart rate, creatinine, and troponin values, as well as cardiogenic shock-hypotension were effective in in-hospital mortality.
- Patients with these characteristics may require more careful management.

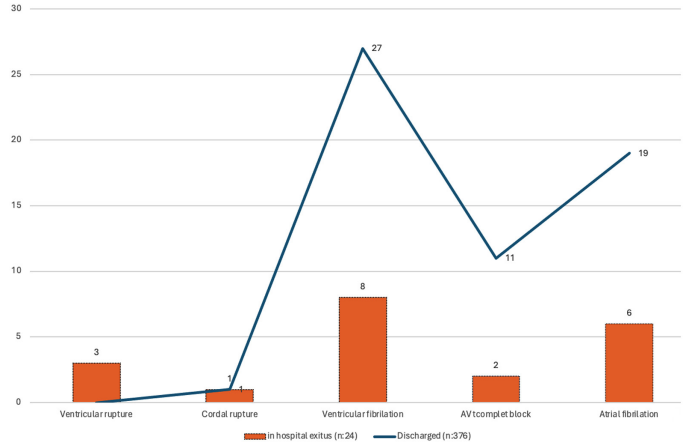

Figure 1. Comparison of the number of complications between the two groups.

STATISTICAL ANALYSIS

Statistical evaluation was performed using Statistical Package for the Social Sciences (SPSS) 16 (SPSS Inc.; Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as percentages. The Kolmogorov–Smirnov test was used to verify the normality of the distribution of continuous variables. Statistical analysis of clinical data between the two groups consisted of unpaired *t*-tests for parametric data, and Mann–Whitney *U*-test analysis for nonparametric data. Continuous variables and categorical variables were analyzed by the chi-squared statistic tests, Student's *t*-test or Kruskal–Wallis test when appropriate. A *P*-value of <.05 was considered statistically significant in all evaluations.

RESULTS

Of the 400 patients involved in the study, 340 (85%) were male and 60 (15%) were female. The mean age of the patients was 58 ± 11 years. Diabetes mellitus existed in 11.2% of the patients, hypertension in 27.5%, smoking history in 56.5%, family history in 13.5%, and hyperlipidemia in 8%. There was no significant difference between the groups regarding basal hemoglobin levels (P = .186). The blood sugar measurements of the patients varied from 55 to 728, with a mean of 152.69 ± 81.50. Total cholesterol levels ranged from 95 to 430, with a mean of 207.20 ± 44.14. LDL levels ranged from 58 to 451, with a mean of 132.56 ± 37.66; high-density lipoprotein (HDL) levels varied from 13 to 85, with a mean of 41.30 ± 9.18; and triglyceride levels ranged from 31 to 718, with a mean of 166.72 ± 108.24. Serum creatinine values ranged from 0.20 to 3.00, with a mean of 1.08 ± 0.33. In patients older than 65 years, in-hospital mortality in follow-up was found

Table 1. Demographical, Clinical, and Laboratory Characteristics of the Patients

	Total Patients' Number (n = 400)	Discharged (n = 376)	In-hospital mortality (n = 24)	*P*
Age, ≥ 65, n (%)	134 (33)	120 (31.9)	14 (58.3)	**.008**
Sex, male n (%)	340 (85)	324 (86)	16 (66.6)	**.017**
Diabetes mellitus, n (%)	45 (11.2)	38 (10)	7 (29.1)	**.011**
Hypertension, n (%)	110 (27.5)	98 (26)	12 (50)	**.011**
Smoke, n (%)	226 (56.5)	217 (57.7)	9 (37.5)	.065
Family history of CAD, n (%)	54 (13.5)	50 (13.2)	4 (16.6)	.658
Dyslipidemia, n (%)	32 (8)	30 (7.9)	2 (8.3)	.910
MI hour, ≥6	42 (10.5)	39 (9.5)	3 (12.5)	.256
MI localization, Anterior, n (%)	223 (55.7)	206 (54.7)	17 (70.8)	.184
Multivessel disease, n (%)	158 (39.6)	145 (38.5)	13 (54.1)	.136
LV- EF, ≤40%	136 (34)	122 (32.4)	14 (58.3)	**.009**
Cardiogenic shock, n	20	2	18	**<.001**
Hypotension, n	11	1	10	**<.001**
Heart rate, ≥100/dk, n	31	22	9	**<.001**
High basal creatinine, n (%)	40 (10)	30 (7.9)	10 (41.6)	**<.001**
High basal troponin, n (%)	278 (69.5)	254 (67.5)	24 (100)	**.001**

CAD, coronary artery disease; MI, myocardial infarction; LVEF, left ventricular ejection fraction.

to be higher compared to patients younger than 65 years (*P* = .008). In our study group, the mortality of women was found to be higher than men (*P* = .041). In patients with DM, in-hospital mortality was found to be statistically significantly higher compared to patients without DM (*P* < .001). In patients with hypertension, in-hospital mortality was found to be higher than in patients without hypertension (*P* = .001). There was an increase in in-hospital mortality in patients with LV EF below 40% (*P* < .001). The presence of shock, hypotension, high heart rate, and elevated troponin levels significantly increased in-hospital mortality (*P* < .05). Contrast-induced nephropathy was observed in 8 (40%) patients in the deceased group and 32 (8.5%) patients in the surviving group (*P* < .05). There was no statistically significant relationship between in-hospital mortality and smoking history, hyperlipidemia, family history, serum cholesterol, LDL, HDL, and triglyceride levels (respectively *P* values: .065, .910, .658, .112, .094, .076, and .144). All patients' demographic, clinical, and laboratory features are in shown Table 1.

DISCUSSION

Our study found that male gender, DM, HT, cardiogenic shock, hypotension, elevated baseline heart rate, creatinine and troponin values, and cardiogenic shock-hypotension were effective in in-hospital mortality factors. Despite the advancements in drug-device technology, classical risk factors still impact mortality.

Coronary heart disease ranks first in both mortality and morbidity in our country, as in developed countries. ST-elevation myocardial infarction is a foremost cause of mortality, especially with its complications.[3,11]

Among the major complications of STEMI are pump failure (cardiogenic shock, heart failure), cardiac rupture (free wall, ventricular septal, and papillary muscle rupture), arrhythmias, post-infarction angina, right ventricle failure, pericarditis, and left ventricle thrombi leading to embolism.[12]

Early revascularization in STEMI significantly reduces the development of complications. Medical and demographic characteristics are related to the development of complications. For example, in acute anterior STEMI, the patient's age, gender, accompanying other diseases, and the number and location of occluded coronary vessels influence the development of complications.[13,14]

Shabbir et al.[15] found that mortality was significantly higher in patients with advanced age (> 70), DM, high Killip class (> 2), anterior localization of myocardial infarction, and those not receiving thrombolytic therapy.

Bauer et al.,[16] in a study involving 47 407 patients, evaluated the association between age and mortality in patients undergoing percutaneous coronary intervention (PCI) with acute coronary syndrome (ACS) and a stable

angina diagnosis. While hospital mortality was lesser in patients over 75 years old than in younger patients, the complication rate was higher. This was associated with clinical, angiographic, and interventional variables.

The study by Neri-Souza et al. provided important insights. It found that in patients undergoing coronary stent placement for any reason, the presence of cardiogenic shock, left ventricle dysfunction, and advanced age (>75) was significantly associated with an increase in major in-hospital complications.[17] These findings have significant implications for the management of such patients.

Our study also examined the relationship between in-hospital mortality and conventional risk factors. Similar to the studies by Shabbir, Bauer, Neri-Souza, and colleagues,[15-17] we observed a statistically significant increase in in-hospital mortality in patients above 65, female gender, and those with DM and HT. This increase in mortality in diabetic patients may be associated with their generally older age, higher comorbidity, and more frequent complications. There was no substantial increase in mortality in those with a family history of coronary artery disease (CAD) and dyslipidemia.

In a study by Jim et al. involving 546 cases, prognosticators of in-hospital mortality were investigated in patients presenting with inferior myocardial infarction. Significant increases in in-hospital mortality were found in patients with advanced age (>75), female gender, accompanying lateral wall ischemia, AV block, bundle branch block, free wall rupture, and those not receiving thrombolytic therapy. These parameters were classified as independent prognosticators of in-hospital mortality.[18]

In our study, we also examined the correlation between mortality and the occurrence of complications such as ventricular septal rupture (VSR), ventricular free wall rupture (VSDR), chordae rupture, ventricular aneurysm, atrial fibrillation (AF), ventricular tachycardia (VT), ventricular fibrillation (VF), Mobitz type 2 block, AV complete block, left bundle branch block (LBBB), right bundle branch block (RBBB), pericarditis, pericardial effusion, LV thrombus, and peripheral embolism. Similar to the study by Jim and colleagues,[18] we discovered a statistically significant increase in in-hospital mortality in patients developing VSDR and RBBB. We also found a significant increase in mortality in patients developing VSR, AF, and VF.

When patients were evaluated for mortality according to clinical characteristics, unlike the study by Shabbir et al.,[15] we did not detect a statistically meaningful increase in in-hospital mortality between patients with anterior and other localizations of MI. This increase in mortality in anterior MI may be attributed to larger myocardial necrosis, lower EF, more frequent complications, and more frequent hemodynamic disturbances.

In a prospective study by Kim Seong et al. involving 9905 patients, the effect of renal deficiency and DM on clinical outcomes in individuals with acute myocardial infarction (AMI) was investigated. Patients were followed for major cardiac events and complications for one year. It was found that in this patient group with these clinical characteristics, there was a higher incidence of major cardiac events and complications, and these factors were significantly associated with poor prognosis.[19] Our study observed similar findings qualitatively in the short term; elevated baseline creatinine levels were linked with increased in-hospital mortality. Also, troponin levels are related to higher in hospital mortality rates.[20,21] As with these studies, we found higher values of basal troponin levels in the mortality group.

As seen in all these studies and our study, risk factors, clinical and laboratory characteristics, and complications in patients presenting with acute coronary syndromes are openly related to patient mortality. Evaluation of these parameters is recommended in current treatment guidelines, and various risk-scoring methods have been developed. Therefore, evaluating these parameters is essential in determining patient risk, guiding treatment, and follow-up.

Our study's significant limitations include a relatively small sample size and the acquisition of patient information from medical records. Moreover, the patients' Killip classes could not be obtained. More extensive studies with more patients can lead to more accurate results.

As a conclusion, in the current study, we aimed to highlight the continued significance of classical risk factors for in-hospital mortality due to STEMI, despite advancements in drug and intervention technologies. In this context, managing risk factors will positively contribute to reducing the in-hospital mortality occurrence of STEMI. However, further comprehensive and long-term studies are required to determine the relationship between classical risk factors and in-hospital mortality more reliably. In conclusion, the current study aimed to highlight the continued significance of classical risk factors for in-hospital mortality due to STEMI despite advancements in drug and intervention technologies. In this context, managing risk factors will positively contribute to reducing the in-hospital mortality occurrence of STEMI. However, further comprehensive and long-term studies are required to determine the relationship between classical risk factors and in-hospital mortality reliably.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Atatürk University Faculty of Medicine (approval no.: 2, date: February 11, 2011).

Informed Consent: N/A. Permission was obtained from the hospital management to scan patient files.

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