Original Article

Comparison of Short-Term Clinical Outcome of Non-ST Elevation versus ST Elevation Myocardial Infarction

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Abstract

Background: *Studies on the prognosis of ST elevation myocardial infarction (STEMI) versus non-ST elevation myocardial infarction (non-STEMI) have shown different results. The present study was designed to compare the early outcome and left ventricular systolic function of patients with ST and non-ST elevation myocardial infarction.*

Methods: *The patients' information was derived from 10,065 consecutive patients hospitalized in Tehran Heart Center with acute MI (2007 patients with STEMI and 8058 with non-STEMI). The baseline clinical characteristics, post-MI complications, left ventricular systolic functions, and 30-day mortality rates were compared.*

Results: *A history of current cigarette smoking, opium addiction, and brain stroke was more frequent in the STEMI patients, whereas hyperlipidemia, hypertension, and obesity were found more in the non-STEMI group. Ejection fraction was higher in the non-STEMI patients than that in the STEMI group, and anterior wall infarction was detected more frequently in the STEMI cases. A history of coronary artery bypass grafting and also percutaneous coronary intervention was observed more in the non-STEMI group. Amongst the in-hospital complications, ventricular arrhythmias (1.4 vs. 0.5, P<0.001) and pulmonary edema (0.4 vs. 0.1, P=0.002) were more prevalent in the STEMI cases. The 30-day mortality rate in the STEMI group was higher than that in the non-STEMI group (5.5 vs. 2.4, P<0.001). Early mortality in both groups was dependant on advanced age, diabetes mellitus, post-MI bradycardia, and atrioventricular block. Also, female gender and pulmonary edema in the STEMI group and family history of MI in the non-STEMI patients could predict 30-day mortality.*

Conclusion: *There were several differences in the baseline characteristics and early outcome between the two types of STEMI and non-STEMI. The 30-day mortality rate was higher in the STEMI group than that in the non-STEMI group.*

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Introduction

Acute myocardial infarction (MI) can be divided into ST elevation MI (STEMI) and non-ST elevation MI (non-STEMI) on the basis of ST changes in the respective leads in the electrocardiogram. The categorization of patients into those with ST elevation and those with non-ST elevation infarction patterns is best conceived of as only a crude guide to the extent of ventricular damage. Prognostic considerations must take into account other important factors such as whether the ECG abnormality is due to a first infarct versus subsequent infarct, the location of infarction (anterior versus

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inferior), infarct size, and demographic factors such as the patient's age.[1] The prognosis of patients with STEMI has improved considerably over the last decade. The introduction of new therapeutic modalities, including invasive cardiac procedures and new medications, probably play a major role in the favorable outcome of these patients.[2]

Studies on the prognosis of STEMI versus non-STEMI have shown different results. Some studies have shown that patients with non-STEMI have a relatively better in-hospital course and a lower early mortality rate.[3] Also, patients with non-STEMI have a relatively high prevalence of spontaneous infarct artery reperfusion, smaller infarct size, and relatively low in-hospital mortality, but a higher rate of post-infarction recurrent ischemic events. It is deserving of note that no significant differences in MI evolution in Killip-Kimbal Class II were reported between the two groups of patients in a previously published paper.[4]

In the present study, we compared the left ventricular systolic functions, early complications, and 30-day mortality rates of patients with STEMI versus non-STEMI and assessed the main factors influencing 30-day mortality in the two types of MI.

Methods

The demographic and clinical characteristics of 10,065 consecutive patients hospitalized in Tehran Heart Center with acute MI [2007 (19.9%) patients with STEMI and 8058 (80.1%) patients with non-STEMI] from January 2004 to January 2006 were collected and entered into a computerized database.

The diagnosis of acute MI was based on the presence of at least two of the following criteria: typical chest pain lasting >30 minutes, unequivocal new electrocardiographic ST segment deviations of one millimeter from the isoelectric line with ischemic T wave changes, serum creatine kinase elevation to >2 times the upper normal limit, concomitant elevation of creatine kinase-MB isoenzyme above the upper normal limit 10, or a typical rise and gradual fall in the troponin level.[5] The distinction between STEMI and non-STEMI was based on serial electrocardiograms performed during hospitalization. The diagnosis of non-STEMI was based on previous clinical and enzymatic criteria without the development of ST elevation during hospitalization, including the pre-discharge ECG.

The following data were also included for analysis: 1) general characteristics: age, gender, and body mass index (BMI); 2) general risk factors: current smoking history (patient regularly smokes a tobacco product/products one or more times per day or has smoked in the 30 days prior to admission),[6] hypercholesterolemia (total cholesterol ≥5.0, HDL-cholesterol ≤1.0 mmol/l in men or ≤1.1 mmol/l in women, triglycerides≥2.0 mmol/l),[7] family history of coronary artery disease (first-degree relatives before the age of 55 in men and 65 years in women),[8] hypertension (systolic blood pressure ≥140 mmHg and/or diastolic ≥90 mmHg and/or on anti-hypertensive treatment),[9] diabetes mellitus (symptoms of diabetes plus plasma glucose concentration≥11.1 mmol/l or fasting plasma glucose≥7.0 mmol/l or 2-hpp≥11.1 mmol/l),[10] opium addiction, renal failure (serum creatinine ≥1.3 mg/dL),[11] brain stroke, and carotid diseases; and 3) cardiac status: previous coronary artery bypass surgery (CABG), percutaneous coronary intervention (PCI), MI, Killip-Kimbal Class, number of defected coronary vessels, left main disease≥50%, and left ventricular ejection fraction before surgery (measured by two-dimensional echocardiography). The post-MI complications were comprised of arrhythmia, pulmonary edema, and cerebrovascular disease.

The results were reported as mean±standard deviation (SD) for the quantitative variables and percentages for the categorical variables. The groups were compared using the Student's t-test for the continuous variables and the chi-square test (or Fisher's exact test if required) or Mantel-Haenszel chi-square test for trend for the categorical variables. The predictors exhibiting a statistically significant relationship with the QoL components in the univariate analyses were taken for a multivariate logistic regression analysis to investigate their independence. Odds ratios (OR) and 95% confidence intervals (CI) for OR were calculated. Model discrimination was measured using the c statistics, which is equal to the area under the Receiver Operating Characteristic (ROC) curve. Model calibration was estimated using the Hosmer-Lemeshow (HL) goodness-of-fit statistics, with higher P values implying that the model fit the observed data better. The data analyzer was anonymous, and data collection and processing were approved by the institutional review board of our heart center. P values of 0.05 or less were considered statistically significant. All the statistical analyses were performed using SPSS version 13 (SPSS Inc., Chicago, IL, USA) and SAS version 9.1 for Windows (SAS Institute Inc., Cary, NC, USA).

Results

Both STEMI and non-STEMI were more frequent in the men, but the male/female ratio in the non-STEMI group was lower than that in the STEMI group (1.23 vs. 2.87, P<0.001). The mean age of the STEMI patients was also lower (61.20±12.38 vs. 62.29±11.85, P<0.001). Amongst the general risk factors for coronary artery disease (Table1), current cigarette smoking, opium addiction, and brain stroke were more frequent in the STEMI group, whereas hyperlipidemia, hypertension, and obesity were found more in the non-STEMI cases. The other risk factors were similar between the two groups. Ejection fraction was higher in the non-STEMI group than that in the STEMI group

Table 1. Characteristics of patients with ST elevation and non-ST elevation myocardial infarction

Characteristics	STEMI (n=2007) (%)	Non-STEMI (n=8058) (%)	P value
Male	74.2	55.2	<0.001
History of CABG	4.4	8.0	<0.001
History of PCI	4.8	6.8	0.001
History of MI	10.3	7.2	<0.001
Family history of CAD	24.1	24.4	0.776
Current cigarette smoking	29.4	19.3	<0.001
History of hyperlipidemia	47.6	53.2	<0.001
History of hypertension	43.6	52.7	<0.001
History of diabetes mellitus	32.7	32.2	0.725
History of opium addiction	9.9	7.1	<0.001
History of renal failure	4.1	3.9	0.680
History of brain stroke	5.3	4.2	0.032
Carotid disease	0.7	1.0	0.212
Obesity (BMI>30 kg/m^2)	18.1	24.7	<0.001
Left main disease	2.1	4.5	0.050
Single-vessel disease	21.3	22.5	0.876
Two-vessel disease	28.1	28.2	0.929
Three-vessel disease	48.5	47.8	0.574
Anterior wall MI	22.4	16.9	<0.001
CABG recommendation	25.5	22.2	0.001
PCI recommendation	10.8	12.0	0.135
Killip-Kimbal Class:			
Class I	82.7	84.5	0.048
Class II	12.8	9.7	<0.001
Class III	2.1	3.6	0.001
Class IV	2.4	2.1	0.407

STEMI, ST elevation myocardial infarction; non-STEMI, non-ST elevation myocardial infarction; CABG, Coronary artery bypass grafting; PCI, Percutaneous coronary intervention; MI, Myocardial infarction; CAD, Coronary artery disease; BMI, Body mass index

(45.91±13.37 vs. 42.24±13.29, P<0.001). However, the mean of Killip-Kimbal Class was similar between the two groups (STEMI=1.24±0.60, non-STEMI=1.23±0.61, P=0.772). Killip Class I was more frequent in the non-STEMI patients, whereas Killip Class II was more frequent in the STEMI cases. Left main lesions had a trend for being more frequent in the non-STEMI cases (P=0.053); previous MI was found more in the other group. Anterior wall infarction was detected more frequently in the STEMI patients (P=0.003) (Table 1). Also, there was no significant difference in the number of defected vessels between the two groups. A history of CABG and also PCI was observed more in the non-STEMI group.

Table 2. In-hospital complications of patients with ST elevation and non-ST elevation myocardial Infarction

Characteristics	STEMI (n=2007) (%)	Non-STEMI (n=8058) (%)	P value
Bradycardia	0.5	0.2	0.018
Atrial fibrillation	1.1	0.8	0.192
Ventricular fibrillation	1.0	0.6	0.050
Ventricular tachycardia	1.4	0.5	<0.001
Atrioventricular block	1.0	0.6	0.050
Pulmonary edema	0.4	0.1	0.002
Cerebrovascular disease	0.1	0.1	0.999
30-day mortality rate	5.5	2.4	<0.001

Amongst the in-hospital complications, ventricular arrhythmias, pulmonary edema, and 30-day mortality were more prevalent in the STEMI group, and other complications were similar between the two groups (Table 2).

The multivariate logistic regression analysis showed that the 30-day mortality rate in the STEMI group was higher than that in the non-STEMI group (OR: 2.332, 95%CI: 1.824-2.939; P<0.001). Also, this analysis showed that 30-day mortality in both groups was dependant on advanced age, diabetes mellitus, post-MI bradycardia, and atrioventricular block. Female gender and pulmonary edema in the STEMI patients and family history of MI in the non-STEMI patients could predict 30-day mortality (Tables 3 and 4).

Table 3. Factors influencing 30-day mortality in patients with ST elevation myocardial infarction

Risk factors	Univariate analysis				Multivariate analysis			
	Odds ratio	95% confidence interval		P value	Odds ratio	95% confidence interval		P value
		Lower	Upper			Lower	Upper	
Male	0.505	0.342	0.746	<0.001	0.487	0.316	0.749	0.001
Age	1.056	1.038	1.074	<0.001	1.044	1.024	1.063	<0.001
Diabetes mellitus	2.583	1.744	3.825	<0.001	2.554	1.656	3.940	<0.001
Bradycardia	10.183	2.935	35.329	<0.001	9.305	2.629	57.581	<0.001
Atrioventricular block	4.173	1.380	12.620	0.011	4.016	1.489	15.577	0.004
Pulmonary edema	14.279	3.779	53.950	<0.001	13.535	3.659	74.717	<0.001

Hosmer-Lemeshow statistic, P=0.6174; The area under the ROC curve, c=0.75613

Table 4. Factors influencing 30-day mortality in patients with non-ST elevation myocardial infarction

Risk factors	Univariate analysis				Multivariate analysis			
	Odds ratio	95% confidence interval		P value	Odds ratio	95% confidence interval		P value
		Lower	Upper			Lower	Upper	
Age	1.060	1.046	1.074	<0.001	1.057	1.041	1.073	<0.001
Family history of CAD	0.268	0.157	0.455	<0.001	0.369	0.215	3.634	<0.001
Diabetes mellitus	1.640	1.229	2.188	0.001	1.353	1.141	2.113	0.005
Bradycardia	18.962	7.131	50.418	<0.001	17.521	6.346	48.378	<0.001
Atrioventricular block	11.860	5.980	23.521	<0.001	11.345	5.555	23.170	<0.001

Hosmer-Lemeshow statistic, P=0.7362; The area under the ROC curve, c=0.73518
CAD, Coronary artery disease

Discussion

In a recent study, we compared pre-MI characteristics, post-MI complications, and mortality in STEMI versus non-STEMI groups. In our study, STEMI and non-SEMI in men were 2.87 and 1.23 times greater than those in women, respectively. Moti Haim et al. observed a similar sex ratio in the two types of MI (male/female in STEMI, 3.0; non-STEMI, 2.0);[2] nonetheless, according to the Lekakis et al. study, there were no significant differences in age and sex variables between the two types of MI.[12] Although it was previously posited that women with acute MI have a worse prognosis than men[13] due to advanced disease, comorbidities, and smaller body surface area,[14,15] more recent studies have demonstrated that such factors as menopause could decline the risk of MI in women. In our study, most of our female patients were in the menopausal age.[16] Furthermore, failure to recognize the prodromal symptoms of MI may be one reason why women tend to experience a greater proportion of MI and its complication than do men.[17]

We found that the in-hospital complications related to cardiac rhythm in the STEMI group were more than those in the non-STEMI group. In the Arriagada study, ventricular arrhythmias and conduction defects were lower in non-STEMI.[18] Also in our study, the prevalence of post-MI cerebrovascular accident was observed to be similar between the two groups and found in 0.1% of each group, whereas the history of brain stroke in the patients with STEMI was more pronounced. In a three-year prospective study of acute cerebrovascular accident, from patients admitted to a geriatric unit within 72 hours of the onset, 12.7% was associated with acute MI.[19] Other studies have shown that patients with prior stroke represent a substantial proportion of patients presenting with acute STEMI; consequently, patients with prior stroke have been reported to account for 6% to 10% of all patients presenting with STEMI.[20-22] It has been reported that the type of acute MI, especially anterior wall MI, is associated with cerebrovascular accident[23,24] and that the associated factors include large infarct size, atrial arrhythmias, cardiac pump failure, Killip Class IV, history of previous MI, and history of previous stroke.[25]

In our study, a history of CABG and PCI was seen more frequently in the non-STEMI patients. In the Kleiman study, 16.4% of the patients with non-STEMI had prior CABG. He showed that prior CABG was not independently associated with the occurrence of death or myocardial infarction.[26] In the Frank et al. study, the percentage of the patients with resting left ventricular ejection fraction >55% was greater in the non-STEMI group.[4] Chiming in with the Frank study, we found that rest ejection fraction in non-STEMI was greater than that in STEMI. Our study is also concordant with the Shaun et al. study insofar as anterior wall myocardial infarction was seen more frequently in STEMI.[27]

According to the results of the present study, the 30-day mortality rate was higher in the STEMI cases. In the Montalescot et al. study, 30-day mortality was similar between the STEMI and non-STEMI groups (4.6 vs. 4.3%). In their study, despite different management, these patients had similar prognoses.[28] In the Nikus study, 30-day mortality in patients with non-STEMI was significantly higher than that in patients with STEMI (13% vs. 9.6%); the rates were higher than the mortality rate in our study. According to the results of the said study, the short-term mortality rate of MI patients, especially those classified as non-STEMI, was still high despite the increasing use of proven treatment modalities.[29] The Terkelsen study demonstrated that in unselected patients, 1-year mortality was significantly higher in the non-STEMI as compared to the STEMI patients.[30] Although early thrombolysis and other preventive approaches could reduce the risk of death in STEMI patients, mortality remains high and the survival of these patients could be predicted by aspirin therapy given acutely and out-of-hospital thrombolysis.[31]

In our study, female gender was a strong predictor of 30-day mortality in STEMI. Also, we showed that the predictive value of diabetes mellitus in the 30-day mortality rate in the STEMI group was more than that in the non-STEMI group, whereas the value of post-MI bradycardia and atrioventricular block for the prediction of the 30-day mortality rate in the non-STEMI patients was higher than that in the STEMI cases. Rasoul et al. showed that age, diabetes mellitus, and

hypertension were independent and significant predictors of mortality in non-STEMI.[32] The De Luca study demonstrated that in patients with STEMI treated with primary angioplasty, the women were associated with a higher mortality rate in comparison with the men, mainly because of their high-risk profile and angiographic features.[33] Also, in the Cohen study, the predictors of death included age >60 years, low systolic blood pressure, higher Killip Class, and high heart rate. They demonstrated that not only was female gender not an independent predictor of outcome but also factors more common in female STEMI patients (advanced age and delayed presentation) were associated with not receiving reperfusion therapy and adverse outcome.[34] In line with our study, the Hanania study found that high age, STEMI, and diabetes mellitus independently predicted 30-day mortality.[35]

Conclusion

In conclusion, the results of the present study showed that there were several differences in the baseline characteristics between the two groups of patients with STEMI and non-STEMI. The 30-day mortality rate in the STEMI group was statistically higher than that in the non-STEMI group. Additionally, the strongest predictors of mortality in both types of MI were advanced age, diabetes mellitus, and post-MI dysrhythmias. Given the role of the region as a predictor of death in MI,[25] the results of our study, as one of the first studies to evaluate and compare STEMI and non-STEMI in Iran, can be useful for the management of these patients in our population.

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