Differences in Clinical Outcomes Between Patients With ST-Elevation Versus Non-ST-Elevation Acute Myocardial Infarction in Korea

Doo Sun Sim, MD, Ju Han Kim, MD and Myung Ho Jeong, MD

The Heart Research Center of Chonnam National University Hospital, Gwangju, Korea

ABSTRACT

In Korea, the incidence of acute myocardial infarction has been increasing rapidly. Twelve-month clinical outcomes for 13,133 patients with acute myocardial infarction enrolled in the nationwide prospective Korea Acute Myocardial Infarction Registry study were analyzed according to the presence or absence of ST-segment elevation. Patients with ST-segment elevation myocardial infarction (STEMI) were younger, more likely to be men and smokers, and had poorer left ventricular function with a higher incidence of cardiac death compared to patients with non-ST-segment elevation myocardial infarction (NSTEMI). NSTEMI patients had a higher prevalence of 3-vessel and left main coronary artery disease with complex lesions, and were more likely to have co-morbidities. The in-hospital and 1-month survival rates were higher in NSTEMI patients than in STEMI patients. However, 12-month survival rates was not different between the two groups. In conclusion, NSTEMI patients have worse clinical outcomes than STEMI patients, and therefore should be treated more intensively during clinical follow-up. **(Korean Circ J 2009; 39:297-303)**

KEY WORDS: Myocardial infarction; Coronary artery disease; Prognosis.

Introduction

The present study reveals 12-month clinical outcomes for 13,133 patients with acute myocardial infarction (AMI) who were enrolled in the nationwide prospective Korea Acute Myocardial Infarction Registry (KAMIR) between November 2005 and December 2007. Launched in November 2005, the KAMIR is the first nationwide, population based, multicenter data collection registry in Korea designed to track outcomes of patients presenting with AMI. The registry includes 52 community and teaching hospitals that enroll more than 10,000 patients annually. As of March 2009, the registry contained data on 21,871 patients. Centers included in the registry were chosen based on a careful evaluation of local demographics and care facilities. Since treatment decisions for patients included in the KAMIR are at the discretion of the patient's physician, data collected in the registry reflect a real-world approach to the diagnosis and treatment of AMI in Korea. The KAMIR is supported by a research grant from the Korean Society of Circulation in commemoration of its 50th Anniversary and aims to improve patient care by providing a greater understanding of patient management and outcomes in the rapidly evolving field of AMI treatment.

Recently in Korea the proportion of non-ST-segment elevation myocardial infarction (NSTEMI) has been increasing, compared with acute ST-segment elevation myocardial infarction (STEMI). We sought to evaluate differences between STEMI and NSTEMI in laboratory and clinical outcomes through the KAMIR in Korean patients.

Comparison of Clinical Outcomes Between ST-Segment Elevation Myocardial Infarction and Non-ST-Segment Elevation Myocardial Infarction

Patients entered into the registry were ≥ 18 years of age at the time of hospital presentation, had to be admitted with an AMI as the presumptive diagnosis, and had ≥ 1 of the following: electrocardiographic changes consistent with an AMI, serial increases in serum biochemical markers of myocardial necrosis, and/or docu-

Correspondence: Myung Ho Jeong, MD, The Heart Research Center of Chonnam National University Hospital, Jaebong-ro, Dong-gu, Gwangju 501-757, Korea
Tel: 82-62-220-6243, Fax: 82-62-227-3105
E-mail: myungho@chollian.net

mentation of coronary artery disease.

The primary clinical end point was the composite of major adverse cardiac events (MACE), including death from any cause, myocardial infarction, target vessel/lesion revascularization, and coronary artery bypass graft-

ing (CABG) during a 12-month clinical follow-up.

Characteristics were examined separately for STEMI and NSTEMI patients (Table 1 and 2). STEMI patients were younger, more likely to be men and smokers, and had poorer left ventricular function with a higher in-

Table 1. Baseline clinical characteristics

	STEMI (n=7,855)	NSTEMI (n=5,278)	p
Age (years)	62.0±12.8	64.3±12.3	
Age group, n (%)			
<55	2,339 (29.8)	1,214 (23.0)	<0.001
55-64	1,889 (24.0)	1,214 (23.0)	0.166
65-74	2,200 (28.0)	1,692 (32.1)	<0.001
≥75	1,427 (18.2)	1,158 (21.9)	<0.001
Men, n (%)	5,800 (73.6)	3,468 (65.4)	<0.001
Medical history, n (%)			
Ischemic heart disease	948 (12.1)	1,206 (22.9)	<0.001
Hypertension	3,577 (46.1)	2,855 (54.4)	<0.001
Diabetes	1,947 (25.2)	1,707 (32.6)	<0.001
Hypercholesterolemia	622 (9.1)	653 (14.1)	<0.001
Current smoking	4,793 (61.4)	2,704 (51.6)	<0.001
Family history	514 (7.4)	335 (7.0)	0.443
CVA history	469 (5.9)	471 (8.9)	<0.001
Heart failure	107 (1.4)	213 (4.0)	<0.001
Peripheral artery disease	61 (0.8)	81 (1.5)	<0.001
LVEF (%)	50.3±14.7	53.8±23.6	<0.001

CVA: cerebrovascular accident, LVEF: left ventricular ejection fraction, STEMI: ST-segment elevation myocardial infarction, NSTEMI: non-ST-segment elevation myocardial infarction.

Table 2. Coronary angiographic findings

	STEMI (n=7,290)	NSTEMI (n=4,385)	p
Number of involved vessels, n (%)			
1 vessel disease	3,335 (45.7)	1,529 (34.9)	<0.001
2 vessel disease	2,188 (30.0)	1,363 (31.1)	0.224
3 vessel disease	1,592 (21.8)	1,305 (29.8)	<0.001
Left main (complex)	150 (2.1)	167 (3.8)	<0.001
Left main (isolated)	25 (0.3)	21 (0.5)	0.256
Infarct related artery, n (%)			
Left main	115 (1.6)	148 (3.4)	<0.001
Left anterior descending	3,735 (51.2)	1,784 (41.0)	<0.001
Left circumflex	706 (9.7)	1,218 (28.0)	<0.001
Right coronary	2,742 (37.6)	1,203 (27.6)	<0.001
ACC/AHA lesion classification, n (%)			
Type A	307 (4.5)	226 (5.6)	0.010
Type B1	1,204 (17.7)	752 (18.7)	0.185
Type B2	1,809 (26.6)	1,179 (29.4)	0.002
Type C	3,470 (51.1)	1,854 (46.2)	0.001
TIMI flow			
TIMI 0	3,704 (53.1)	1,183 (28.8)	<0.001
TIMI 1	747 (10.7)	537 (13.1)	<0.001
TIMI 2	1,030 (14.8)	754 (18.4)	<0.001
TIMI 3	1,500 (21.5)	1,631 (39.7)	<0.001

STEMI: ST-segment elevation myocardial infarction, NSTEMI: non-ST-segment elevation myocardial infarction, ACC/AHA: American College of Cardiology/American Heart Association, TIMI: thrombolysis in myocardial infarction

cidence of cardiac death, compared to NSTEMI patients (Table 3 and 4). NSTEMI patients had a higher prevalence of 3-vessel and left main coronary artery disease with complex lesions, and were more likely to have co-morbidities (Table 1 and 2).

The in-hospital and 1-month survival rates were higher in patients with NSTEMI than in patients with STEMI (Figs. 1 and 2). However, 12-month survival rate was not different between patients with NSTEMI and STEMI (Fig. 3).

Predictors of mortality in STEMI patients during 12-month follow up were presence of ventricular tachycardia/fibrillation, decreased left ventricular function, multi-vessel disease, and age (Table 5). In NSTEMI patients,

Table 3. In-hospital mortality and one-month MACEs

	STEMI (n=7,890)	NSTEMI (n=5,103)	p
In-hospital death, n (%)	504 (6.4)	199 (3.8)	<0.001
1-month MACE, n (%)			
Cardiac death	571 (8.5)	255 (5.7)	<0.001
Non-cardiac death	27 (0.4)	19 (0.4)	0.501
Myocardial infarction	30 (0.4)	33 (0.7)	0.821
Repeat PCI	62 (1.0)	37 (0.9)	0.324
Target vessel revascularization	18 (0.2)	14 (0.2)	0.648
Non-target vessel revascularization	41 (0.5)	22 (0.4)	0.303
Target lesion revascularization	16 (0.2)	10 (0.2)	0.973
Coronary artery bypass grafting	16 (0.2)	20 (0.4)	0.254
Composite MACE	705 (10.4)	364 (8.2)	0.003

PCI: percutaneous coronary intervention, STEMI: ST-segment elevation myocardial infarction, NSTEMI: non-ST-segment elevation myocardial infarction, MACEs: major adverse cardiac events

Table 4. Twelve-month MACEs

	STEMI (n=5,110)	NSTEMI (n=3,315)	p
12-month MACE, n (%)			
Cardiac death	630 (12.3)	315 (9.5)	0.009
Non-cardiac death	67 (1.3)	61 (1.8)	0.681
Myocardial infarction	51 (1.0)	63 (1.9)	0.072
Repeat PCI	389 (7.6)	210 (6.3)	0.110
Target vessel revascularization	69 (1.5)	42 (1.4)	0.516
Non-target vessel revascularization	190 (3.7)	94 (2.8)	0.227
Target lesion revascularization	138 (2.7)	79 (2.3)	0.574
Coronary artery bypass grafting	25 (0.5)	27 (0.8)	0.132
Composite MACE	1162 (22.7)	676 (20.4)	0.121

PCI: percutaneous coronary intervention, STEMI: ST-segment elevation myocardial infarction, NSTEMI: non-ST-segment elevation myocardial infarction, MACEs: major adverse cardiac events
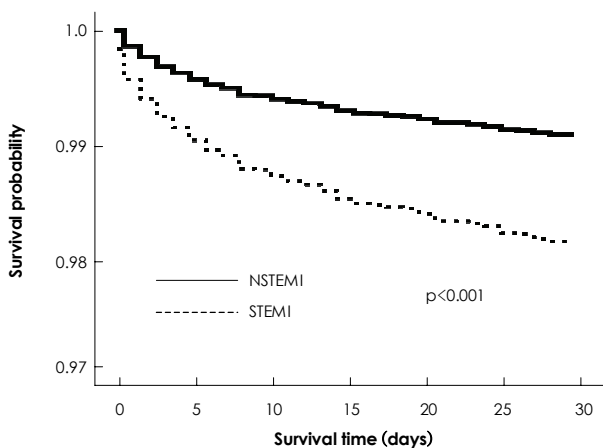

Fig. 1. In-hospital survival rate was higher in non-ST-segment elevation myocardial infarction (NSTEMI) patients than in ST-segment elevation myocardial infarction (STEMI) patients.
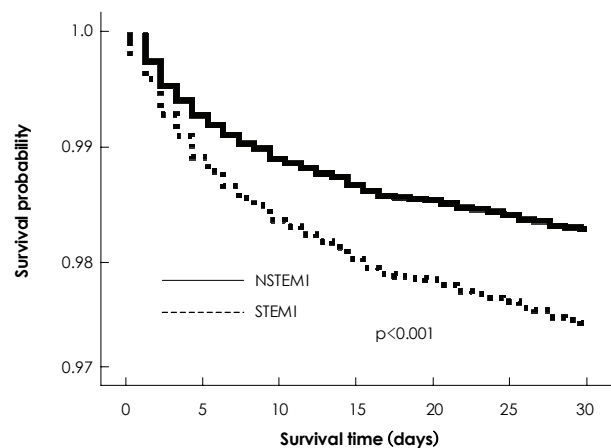

Fig. 2. One-month survival rate was higher in non-ST-segment elevation myocardial infarction (NSTEMI) patients than in ST-segment elevation myocardial infarction. (STEMI) patients.

ventricular tachycardia/fibrillation, decreased left ventricular function, and multi-vessel disease were associated with 12-month all-cause mortality (Table 5).

In both groups, a high percentage of patients received drug-eluting stents (DES), the outcomes of which were superior to those of bare-metal stents (BMS) with significantly lower rates of death and target lesion revascularization at 12-month follow-up (Table 6). Among patients who underwent DES implantation, 12-month clinical outcomes were similar between patients treated with sirolimus-eluting stents (Cypher stent, Cordis, Johnson & Johnson, Miami Lakes, FL, USA) and paclitaxel-eluting stents (Taxus stent, Boston Scientific Corp, Natick, MA, USA) (Table 7) (Fig. 4).

One of the main limitations of this study is that the proportion of patients followed up was relatively low with 63.0% at 6 months and 52.5% at 12 months. Although our follow-up rate was less than the rate typically observed in randomized trials, the characteristics of patients lost to follow-up were relatively similar to those remaining under observation.

Discussion

According to the KAMIR, the in-hospital survival rate was higher in NSTEMI patients than in STEMI patients. However, the 1-year survival rate was not different between the two groups, indicating that in the Korean population NSTEMI patients should be treated as intensively as STEMI patients during clinical follow-up.

The KAMIR study, launched in commemoration of the 50th anniversary of the Korean Society of Circula-
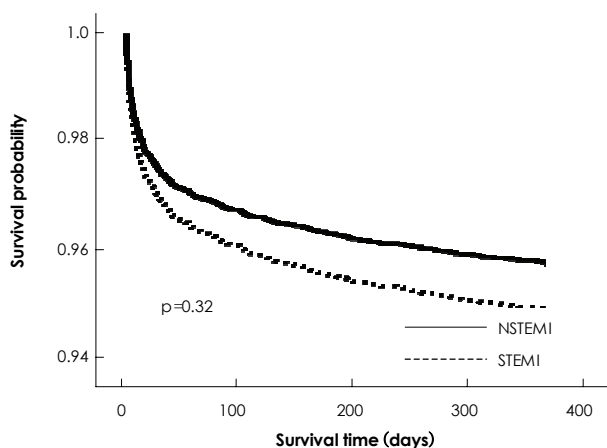
Fig. 3. Twelve-month survival rates were not different between non-ST-segment elevation myocardial infarction (NSTEMI) patients and ST-segment elevation myocardial infarction (STEMI) patients.
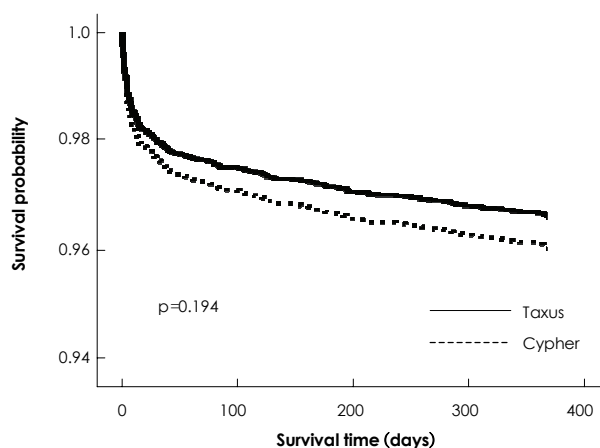
Fig. 4. Post-discharge survival at 12 months after implantation of Cypher and Taxus stents was not different between the two drug-eluting stents.

Table 5. Predictors of mortality during 12-month clinical follow-up in NSTEMI and STEMI patients

Variables	STEMI		NSTEMI	
	HR (95% CI)	p	HR (95% CI)	p
Age				
≤55	1.0	0.014		0.477
55-64	0.34 (0.18-0.67)	0.002		0.217
65-74		0.070		0.195
≥75		0.067		0.557
Medical history				
Myocardial infarction		0.140		0.140
Previous PCI		0.460		0.635
Heart failure		0.171		0.927
Complications during hospitalization				
Heart failure		0.445		0.753
Acute renal failure		0.571		0.150
Atrioventricular block		0.616		0.326
Ventricular tachycardia/fibrillation	2.41 (1.41-4.13)	<0.001	5.78 (2.51-13.31)	<0.001
LVEF decrease	2.20 (1.51-3.22)	<0.001	2.15 (1.45-3.20)	<0.001
Multi-vessel disease	1.38 (1.13-1.68)	0.001	1.49 (1.23-1.83)	<0.001

STEMI: ST-segment elevation myocardial infarction, NSTEMI: non-ST-segment elevation myocardial infarction, PCI: percutaneous coronary intervention, LVEF: left ventricular ejection fraction, HR: hazard ratio, CI: confidence interval

Table 6. Twelve-month MACEs between bare-metal and drug-eluting stents

(%)	Bare-metal stents (n=650)	Drug-eluting stents (n=5,948)	p
Stent size (mm)	21.6±5.6	25.3±6.4	<0.001
Stent diameter (mm)	3.4±0.6	3.1±0.4	<0.001
12-month MACE			
Cardiac death	66 (10.2)	105 (6.8)	0.006
Non-cardiac death	20 (3.1)	68 (1.1)	<0.001
Myocardial infarction	6 (0.9)	60 (1.0)	0.876
Repeat PCI	68 (10.5)	478 (8.0)	0.009
Target vessel revascularization	11 (1.7)	89 (1.5)	0.595
Non-target vessel revascularization	20 (3.0)	240 (4.0)	0.018
Target lesion revascularization	40 (6.1)	159 (2.6)	<0.001
Coronary artery bypass grafting	2 (0.3)	17 (0.3)	0.719
Composite MACE	162 (24.9)	1,025 (17.4)	<0.001

PCI: percutaneous coronary intervention, MACEs: major adverse cardiac events

Table 7. Twelve-month MACEs between Cypher and Taxus stents

(%)	Cypher (n=2,892)	Taxus (n=2,233)	p
Stent size (mm)	26.2±6.6	25.2±6.3	<0.001
Stent diameter (mm)	3.1±0.4	3.2±0.4	0.014
12-month MACE			
Cardiac death	178 (6.2)	143 (6.4)	0.597
Non-cardiac death	33 (1.1)	22 (1.0)	0.071
Myocardial infarction	30 (1.0)	26 (1.2)	0.576
Re-PCI	203 (7.0)	195 (8.7)	0.282
Target vessel revascularization	45 (1.5)	30 (1.3)	0.139
Non-target vessel revascularization	108 (3.7)	100 (4.5)	0.627
Target lesion revascularization	54 (1.8)	69 (3.0)	0.153
Coronary artery bypass grafting	7 (0.2)	5 (0.2)	0.192
Composite MACE	451 (15.6)	391 (17.5)	0.962

MACEs: major adverse cardiac events, PCI: percutaneous coronary intervention

tion, is the first large-scale, nationwide multicenter trial in Korea and has value in helping clinicians understand the real-world epidemiology and management status of AMI in the Korean population. Intensive follow-up and surveillance of the enrollees, as suggested above, is an essential requisite for the ultimate goal of the KAMIR, i.e., establishment of a validated prediction model for mortality risk and prognosis in patients with AMI.

Since its inception in 2005, this study has generated over 100 published papers and invited high-profile international conference presentations. So far, as many as 11 scientific papers have been published in leading international journals. Lee et al.[1] proved that the rates of MACE and stent thrombosis at 6 months after discharge were not different between the two types of DES, i.e. Cypher and Taxus stents, indicating that DES can be safely used in patients with AMI. Song et al.[2] reported that 1-month mortality was not associated with initial time variables to reperfusion, suggesting that patient prognosis may not depend on the initial treatment delay in the current practice of primary percutaneous coronary intervention (PCI) in Korea. Jeong et al.[3] indicated that

intensive pharmacologic treatment may improve short-term clinical outcomes in NSTEMI patients who were not indicated for PCI. Lee et al.[4] reported that clinical outcomes were dependent on the status of estimated glomerular filtration rate (GFR) in patients who underwent invasive treatment. They also suggested that high waist-to hip ratio and underweight are mortality risk factors in STEMI patients.[5] Lee et al.[6] observed that the success rate of PCI for NSTEMI was lower and 1-month MACE for both STEMI and NSTEMI were higher in females than males, even though there was no gender difference in the initial treatment of strategy AMI. Kwon et al.[7] reported that baseline N-terminal pro-B type natriuretic peptide (NT-proBNP) level was associated with shortterm mortality in STEMI patients who underwent primary PCI, and that NT-proBNP level on admission could be used as a prognostic factor in STEMI patients treated with primary PCI. Lee et al.[8] reported that the incidence of AMI showed seasonal and monthly variations and that meteorological parameters had a significant influence on the occurrence of AMI, particularly in females and in patients of younger age. They

also reported that predictors of 6-month MACE in 30-day survivors of AMI included body mass index, severity of left ventricular systolic dysfunction, residual myocardial ischemia, and electrical instability.[9] Furthermore, Chen et al.[10] demonstrated that triple anti-platelet including aspirin, clopidogrel, and cilostazol was superior to conventional dual anti-platelet therapy in preventing MACE without increasing bleeding complications in pa-tients with AMI undergoing PCI. Sim et al.[11] evaluated the safety and benefit of early, elective PCI after thrombolytic therapy for AMI and reported that PCI within 48 hours of successful fibrinolysis was safe and more beneficial compared with PCI performed later. Cho et al.[12] identified risk factors for AMI in young Korean patients. Lee et al.[13] reported that hypertensive AMI patients with diabetes had worse prognoses than those without diabetes.

Analyses and research continue to the present day. The results have also provided impetus for a subsequent study, the Korea Working Group on Myocardial Infarction (KorMI). The KorMI, which is a continuation of the KAMIR, is an ongoing, open-ended registry that captures data on the complete spectrum of patients experiencing AMI, including long-term clinical follow-up. The KAMIR Scientific Committee and the Korean Society of Cardiology are actively discussing the transformation of the KorMI into a regular working group to ensure continuity and stability. It is the strong feeling of the KAMIR Scientific Committee that the KorMI should evolve into a regular society immediately, based on the success of the KAMIR from 2005 and on the fruitful results it has since achieved.

A clear understanding of the key messages the KAMIR delivers to the cardiology community will serve as a stepping stone to better care and treatment of AMI in the Korean population. The observation that hypertension and smoking were the most prevalent risk factors in the KAMIR population warrants establishing more aggressive management of hypertension and a more vigorous country-level campaign against cigarette smoking. In addition, it is mandatory to promote continuous public awareness about the importance of early access to treatment in order to reduce the time delay in seeking medical attention from the onset of perceived symptoms.

Conclusion

The number of patients surviving AMI is on a steady rise with the use of new drug therapies and non-drug interventions. Overall in-hospital mortality of AMI patients is about 5% in Korea. The proportion of NSTEMI patients is increasing and there is a growing need for intensive surveillance and rehabilitation programs, especially for this subset of AMI patients. The KAMIR, with continued expansion and successful growth, will make an invaluable contribution to the long-term care and monitoring of outcomes in Korean patients with AMI.

Korea Acute Myocardial Infarction (KAMIR) Investigators:

Myung Ho Jeong, MD, Young Keun Ahn, MD, Shung Chull Chae, MD, Jong Hyun Kim, MD, Seung Ho Hur, MD, Young Jo Kim, MD, In Whan Seong, MD, Dong Hoon Choi, MD, Jei Keon Chae, MD, Taek Jong Hong, MD, Jae Young Rhew, MD, Doo Il Kim, MD, In Ho Chae, MD, Jung Han Yoon, MD, Bon Kwon Koo, MD, Byung Ok Kim, MD, Myoung Yong Lee, MD, Kee Sik Kim, MD, Jin Yong Hwang, MD, Myeong Chan Cho, MD, Seok Kyu Oh, MD, Nae Hee Lee, MD, Kyoung Tae Jeong, MD, Seung Jea Tahk, MD, Jang Ho Bae, MD, Seung Woon Rha, MD, Keum Soo Park, MD, Chong Jin Kim, MD, Kyoo Rok Han, MD, Tae Hoon Ahn, MD, Moo Hyun Kim, MD, Ki Bae Seung, MD, Wook Sung Chung, MD, Ju Young Yang, MD, Chong Yun Rhim, MD, Hyeon Cheol Gwon, MD, Seong Wook Park, MD, Young Youp Koh, MD, Seung Jae Joo, MD, Soo Joong Kim, MD, Dong Kyu Jin, MD, Jin Man Cho, MD, Yang Soo Jang, MD, Jeong Gwan Cho, MD and Seung Jung Park, MD

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