Recent Update of Korea Acute Myocardial Infarction Registry (KAMIR)

Doo Sun Sim and Myung Ho Jeong

Korea Acute Myocardial Infarction Registry (KAMIR) is the first nationwide registry and reflects the current therapeutic approaches and management for acute myocardial infarction (AMI) in Korea. The results of KAMIR demonstrated different risk factors and different responses to medical and interventional therapies. The prevalence of hypertension, diabetes mellitus and dyslipidemia has increased, but smoking has decreased remarkably. Different pattern of dyslipidemia was demonstrated. The KAMIR score was better than TIMI and GRACE scores in the prediction of long-term mortality in AMI patients. Triple antiplatelet therapy, consisting of aspirin, clopidogrel and cilostazol, was effective in preventing adverse clinical outcomes after percutaneous coronary intervention (PCI). Prasugrel and ticagrelor could not reduce ischemic events, but increased bleeding risk in Korean patients. Therefore, we may recommend low dose prasugrel and ticagrelor compared with Western patients. Statin therapy was effective in Korean AMI patients, including those with very low levels of low density cholesterol and spasm-induced AMI. Statin and ezetimibe was effective in high-risk AMI patients, such as diabetes, old age and systolic heart failure. PCI and its success rates of ST-elevation myocardial infarction (STEMI) are 96.7% and 99.4%, and those of non-ST-elevation myocardial infarction (NSTEMI) 82.7% and 99.5%, respectively. Drug-eluting stents were effective and safe in AMI patients with no increased risk of stent thrombosis in Korean patients. KAMIR will provide new therapeutic strategies and effective methods for secondary prevention of AMI and new guidelines for Asian patients.

KEY WORDS: myocardial infarction, percutaneous coronary intervention, risk factors, statins
2013 in STEMI patients and from 51.1% in 2006 to 34.5% in NSTEMI patients\textsuperscript{17}. Smoking in female patients is one of the predictive factors of major adverse cardiac events (MACE) according to multivariate logistic regression analysis\textsuperscript{21}. The pattern of dyslipidemia in Korean patients is different from that of Western patients. In Korean patients, the mean value of low density lipoprotein (LDL)-cholesterol is 113.8±38.7 mg/dl in STEMI, 109.6±39.6 mg/dl in NSTEMI, which is not so high compared with Western patients. The mean level of triglycerides (TG) was 139.8±124.5 mg/dl in STEMI and 128.9±114.9 mg/dl in NSTEMI, and that of high density lipoprotein (HDL)-cholesterol was 42.6±12.3 mg/dl in STEMI and 43.1±12.7 mg/dl in NSTEMI in Korean patients\textsuperscript{21}. About half of the AMI patients have low HDL-C and one quarter of AMI patients have high TG in Korea. In these patients, statin therapy was not effective in the secondary prevention of AMI during one-year clinical follow-up. Therefore, differential benefit of statin was demonstrated in Korean patients\textsuperscript{21}. TG/HDL-C ratio higher than 3.35 was associated with development of overall MACE\textsuperscript{8}. Obesity has been decreased from 41.2% to 35.0% in STEMI and from 41.1% to 35.1% in NSTEMI between 2006 and 2013 in Korea\textsuperscript{15}. Low level of HDL-C in overnight fasting status is associated with high in-hospital mortality in STEMI patients, not in NSTEMI patients\textsuperscript{21}. Two target goals of LDL-C were compared in Korean AMI patients: 50% reduction from baseline vs. <70 mg/dl. More than 50% reduction of LDL-C from baseline was associated with reduction of MACE during 2-year clinical follow-up, but not in target LDL-C goal <70 mg/dl\textsuperscript{10}. 

AMI patients with low (<100/60 mmHg) and high (>170/100 mmHg) blood pressures in KAMIR are associated with MACE. Therefore J-curve phenomenon was observed in the blood pressure of Korea patients\textsuperscript{17}. Hypoglycemia (<70 mg/dl) and hyperglycemia (≥260 mg/dl) are associated with higher one-month mortality in diabetic and non-diabetic patients. Especially, hypoglycemia in poorly controlled type 2 diabetic patients predicts one-month mortality in Korean AMI patients\textsuperscript{22}. Under-nutrition at admission influences on clinical outcome in AMI and is associated with high post-AMI complications and high in-hospital mortality. According to Geriatric Nutritional Risk Index, under-nutrition was present in 18% of AMI patients\textsuperscript{19}.

IV. Risk Scores [KAMIR Scores]

The KAMIR score was proposed to be a predictor of the prognosis of AMI patients, and KAMIR score was compared with Western score systems, such as Thrombolysis In Myocardial Infarction (TIMI) and Global Registry of Acute Coronary Events (GRACE) scores in the prediction of long-term mortality. New score system for NSTEMI include TIMI risk index, Killip class and serum creatinine\textsuperscript{16}. This score systems predict more precisely than Western scores. Hospital discharge score system for all AMI patients was composed of age, Killip class, PCI, serum creatinine, left ventricular ejection fraction <40% and admission hyperglycemia >180 mg/dl. KAMIR score was better than GRACE score in the prediction of one-year mortality after discharge\textsuperscript{19}. A new score system including biomarkers (high-sensitivity-C-reactive protein [hs-CRP], glomerular filtration rate, N-terminal pro-brain natriuretic peptide) predicts all cause-mortality in NSTEMI patients in Korean patients. CHA2DS2-VASc scoring system can be used as a screening method for high-risk AMI patients and high score predicts in-hospital mortality and complications\textsuperscript{16}. More than 80% reduction of hs-CRP is related to secondary prevention in one-year survivors after AMI in Korea\textsuperscript{17}. Simple ACEF (age, creatinine, ejection fraction) score can predict one-year mortality in 30-day survivors who underwent PCI after AMI\textsuperscript{18}.

V. Medical Treatment

Triple anti-platelet therapy including aspirin, clopidogrel and cilostazol, is associated with lower development of MACE compared with dual anti-platelet therapy in AMI patients who underwent primary PCI, especially in diabetic patients\textsuperscript{30}. Standard or low dose maintenance dosage of prasugrel (10 mg and 5 mg) is associated with lower level of platelet reactivity unit compared with triple anti-platelet therapy in STEMI patients\textsuperscript{20}. Thus, low dose 5 mg prasugrel can be used in Korean patients with STEMI. In Western countries, ticagrelor reduces ischemic events without increasing risk of bleeding complications. However, ticagrelor does not reduce MACE but increases TIMI major and minor bleeding risks in Korean patients\textsuperscript{31}. Therefore, reduced dosage of ticagrelor may be beneficial in Korean AMI patients.

Early statin therapy in AMI patients who have extremely low LDL-C (<70 mg/dl) was effective in the reduction of cumulative incidence of MACE\textsuperscript{21}. Early statin therapy in statin-naïve patients with cardiogenic shock from the KAMIR who underwent revascularization was associated with lower in-hospital mortality and MACE at 12 months\textsuperscript{21}. Statin therapy was effective in spasm induced AMI patients in terms of MACE-free survival\textsuperscript{23}. Statin plus ezetimibe could not reduce MACE compared with high-intensive statin in Korean AMI patients. In subgroup analysis, statin plus ezetimibe was effective in high risk patients, such as diabetes mellitus, old age and low left ventricular ejection fraction\textsuperscript{25}.

In Korean AMI patients, angiotensin receptor blocker (ARB) is better than angiotensin converting enzyme inhibitor (ACEI) in STEMI patients, including subgroups of old age, female, diabetic, high Killip class, multi-vessel disease and the left anterior descending artery as the infarct-related artery\textsuperscript{32}. Surmountable ARB, such as valsartan, candesartan, irbesartan, telmisartan and
olmesartan, is better than surmountable ARB (losartan, eprosartan) in the development of MACE in Korean patients. Renin-angiotensin system inhibitor was effective in STEMI patients with normal and abnormal left ventricular function who underwent successful late PCI.

VI. Interventional Treatment

Door-to-balloon time in STEMI patients has been reduced to less than 60 minutes in major primary PCI centers participated in KAMIR, but one-month mortality has not been decreased. Total ischemic time less than 180 minutes is associated with one-month mortality. Thus, shortening of symptom to door time may be more important than shortening of door to balloon time in Korea. Pharmacoinvasive strategy in STEMI patients who underwent primary PCI has comparable clinical outcomes to patients who underwent primary PCI. If PCI-related delay is longer than 100 minutes, pharmacoinvasive treatment can be recommended in STEMI patients. Early elective PCI within 48 hours after successful thrombolytic therapy for acute STEMI was associated with a more favorable clinical outcome than patients who underwent PCI later. PCI in stable, early latecomers with STEMI presenting 12 to 72 hours after symptom onset reduced mortality and the incidence of death/myocardial infarction (MI) at 12 months. Multi-vessel PCI in multi-vessel coronary artery disease is associated with higher MACE-free survival and death/MI-free survival compared with culprit-only PCI in NSTEMI patients. About 52% of STEMI patients have non-infarct related coronary artery disease and one-month mortality is higher in STEMI patients with multi-vessel lesions in Korea. Three-year clinical outcomes of staged PCI are better than ad hoc or culprit-only PCI in STEMI patients with multi-vessel diseases.

Rates of PCI were 96.7% in STEMI and 82.7% in NSTEMI, and the success rates were 99.4% and 99.5%, respectively, which were relatively higher in Korea than in Western countries. Patients with culprit left main coronary artery stenosis had higher in-hospital mortality than patients with non-culprit left main coronary artery, but had similar clinical outcome during a 12-month follow-up. Penetration rate of DES is higher than 90% (97% currently) in Korea. The event rates are lower in DES implanted group compared with bare metal stent (BMS) group by reduction of repeat intervention, not increasing mortality, MI and stent thrombosis. DES in large vessels in AMI was associated with lower need for repeat revascularization compared to BMS without compromising the overall safety over the course of one-year follow-up. Zotarolimus-and everolimus-eluting stents have comparable clinical outcomes in STEMI patients with chronic kidney disease (CKD) undergoing primary PCI. In the management of NSTEMI with CKD, deferred invasive group is associated with higher death/MI-free survival rate than early invasive group. In octogenarian patients with NSTEMI, there was no difference in MACE-free survival between early and delayed intervention group. In NSTEMI patients, immediate PCI less than 4 hours was associated with lower major bleeding and shorter hospital stay compared with non-immediate PCI group in Korea. However, MACE were not different between immediate and non-immediate PCI. These results were different from Western countries.

In octogenarian AMI patients, DES is associated with lower stent thrombosis rate compared with BMS and all major cardiac events are not different between DES and BMS groups. In patients with metabolic syndrome and AMI, patients-oriented composite events (POCE) were not different between Resolute® zotarolimus-eluting stents versus everolimus-eluting stents during after propensity score-matched analysis.

Use of the intra-aortic balloon pump for resuscitated patients with AMI complicated by cardiac arrest could not reduce cumulative incidence of mortality compared with control group. Intravascular ultrasound (IVUS) guided PCI is performed in about 20% of AMI patients, but cumulative survival is not different from non-IVUS group. Thrombus aspiration during primary PCI could not reduce MACE in STEMI patients, but thrombus aspiration was associated with better clinical outcome in subgroups, such as use of platelet glycoprotein IIb/IIIa receptor blocker and lesion location in left anterior descending artery. The effect of manual thrombus aspiration on 12-month outcome showed a U-shaped relationship, indicating that the impact of thrombus aspiration may become clinically relevant with longer total ischemic time.

VII. Conclusion

Risk factors of Korean AMI patients are different from Western countries. Smoking history in Korean patients is relatively higher than Western patients and lipid profiles are different from Western patients. Statin therapy is not effective in AMI patients with high TG and low HDL-C. KAMIR score is better than TIMI or GRACE scores in the prediction of one-year mortality. ARB is better than ACEI in Korea patients; especially insurmountable ARB will be more effective than surmountable ARB. Low dose prasugrel or ticagrelor will be beneficial to prevent bleeding complications. In multi-vessel diseases, staged PCI for STEMI and multi-vessel PCI in NSTEMI can be recommended. DES is safer and more effective than BMS in Korean AMI patients. Octogenarian can be treated by elective PCI using second generation DES. Thrombus aspiration and IVUS-guide PCI can be recommended in selected patients. KAMIR will provide new therapeutic strategies and effective methods for secondary prevention of AMI and ischemic heart failure in Korean patients. KAMIR study will be useful in the establishment of Asian AMI
guidelines in the future.

All authors declare no conflict of interest.

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