Effect of Pre-Procedural Beta-Blocker on Clinical Outcome after Percutaneous Coronary Intervention in Acute Coronary Syndrome
From the 2014 K-PCI Registry

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Summary
The efficacy of pre-procedural beta-blocker use in patients with acute coronary syndrome (ACS) is not well established in the current percutaneous coronary intervention (PCI) era. We investigate the effect of pre-procedural beta-blocker use on clinical outcomes in patients with ACS undergoing PCI. Among 44,967 consecutive cases of PCI enrolled in the nationwide, retrospective, multicenter registry (K-PCI registry), 31,040 patients with ACS were selected and analyzed. We classified patients into pre-procedural beta-blocker group (n = 8,678) and pre-procedural no-beta-blocker group (n = 22,362) according to the use of beta-blockers at least for two weeks before index PCI. Propensity score-matching analysis was performed and resulted in 7,445 pairs. The primary outcome was in-hospital cardiac death. In propensity score-matched populations, the pre-procedural beta-blocker group had a lower incidence of in-hospital cardiac death compared with the pre-procedural no-beta-blocker group (1.1% versus 2.0%, unadjusted odds ratio [OR]: 0.56, 95% confidence interval [CI]: 0.42-0.73, P < 0.01). In subgroup analysis, the pre-procedural beta-blocker group had a lower incidence of in-hospital cardiac death compared with the pre-procedural no-beta-blocker group in ST-segment elevation myocardial infarction subpopulation (3.1% versus 6.1%, unadjusted OR: 0.49, 95% CI: 0.34-0.71, P < 0.01) and non-ST-segment elevation myocardial infarction subpopulation (1.5% versus 2.9%, unadjusted OR: 0.51, 95% CI: 0.33-0.79, P < 0.01). However, in unstable angina subpopulation, the in-hospital cardiac death rate was comparable between both groups. In conclusion, the use of pre-procedural beta-blocker was associated with a lower risk of in-hospital cardiac death in patients with ACS undergoing PCI. This result adds to the body of evidence that use of pre-procedural beta-blocker in patients with ACS might be reasonable.

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Key words: Coronary artery disease, Pre-procedural medication, Cardiac death

In recent years, the beneficial effect of beta-blockers in coronary artery disease (CAD) has become controversial, especially in relatively low-risk patients without prior myocardial infarction (MI) or systolic heart failure (HF). However, historically, beta-blockers have been used one of the standard of care for patients with CAD, including acute MI. Currently, the American College of Cardiology/American Heart Association (ACC/AHA) guidelines recommend early initiation of beta-blocker in ST-segment elevation myocardial infarction (STEMI) or non-ST-segment elevation acute coronary syndrome (NSTEMI) patients without contraindication of their use and recommend beta-blocker as initial therapy for relief of symptoms in patients with stable CAD. Even though clinical evidence support this recommendation derived from studies conducted before the introduction of the current percutaneous coronary intervention (PCI) practice, beta-blockers remain crucial component of optimal medi-
clinical therapy in patients with ACS or residual ischemia in the current PCI era. In daily use of beta-blockers, clinical uncertainty exists regarding their effectiveness as pre-procedural beta-blocker therapy. Therefore, we investigated clinical outcomes in patients with ACS presentation undergoing PCI according to pre-medication of oral beta-blockers in current PCI practice using nationwide PCI registry.

Methods

Study population: The study population was selected from the K-PCI registry 2014, a retrospective multicenter registry of patients with CAD who underwent PCI during 2014. This registry was sponsored by the Korean Society of Cardiology and the Korean Society of Interventional Cardiology. All consecutive patients were enrolled from 92 high-volume PCI centers in Korea. This registry was an all-comer study with no specific exclusion criteria. The local Institutional Review Board at each center approved this study. Informed consent was waived at all centers, considering the study’s retrospective enrollment without clinical follow-up design. Between January 1, 2014 and December 31, 2014, a total of 44,967 consecutive cases of PCI were enrolled in this registry. Clinical, laboratory, and in-hospital outcome data were collected by a trained study coordinator using a standardized case report form and protocol in a web-based reporting system. In the present analysis, for duplicated patients undergoing multiple PCIs, the initial PCI was considered as the index PCI. Patients with cardiogenic shock or cardiopulmonary resuscitation and patients with an uncertain record of beta-blocker medication within last two weeks before the index PCI were excluded. Among the patients included, 11,250 patients were presented with non-ACS and 31,040 patients with ACS. For the analysis of this study, patients with ACS were divided by use of beta-blockers in the two weeks prior to the index PCI into a pre-procedural beta-blocker group and a pre-procedural no-beta-blocker group. Considering the tolerability of beta-blocker therapy, patients who used beta-blocker medication for more than two weeks before the index PCI were considered as pre-procedural beta-blocker group. The patient flow of the study is shown in Figure 1.

PCI procedure and pre-procedural medication: Antiplatelet medications before the PCI and coronary interventions were performed according to the current standard procedural guideline. Anticoagulation therapy during PCI was performed according to current practice guideline by the Korean Society of Interventional Cardiology. The treatment strategies during PCI were all left to the operator’s discretion. The pre-procedural antiangiinal medications, including beta-blockers, calcium-channel blockers, long-acting nitrates, nicorandil, or trimetazidine, were considered that patients has taken or has been oral medication within the two weeks prior to index PCI.

Definition and outcomes: Clinical presentation at procedure were classified into five categories by an attending physician in each hospital based on the following criteria: 1) Silent ischemia was defined in patients with no symptoms or symptoms that were unlikely to be ischemic pain; 2) Stable angina was defined in patients with angina symptoms that did not change in frequency or pattern in the six weeks prior to the index PCI or that were controlled by rest and/or oral antiangiinal medications; 3) Unstable angina was defined in patients with rest angina (occurring during rest and prolonged, usually > 20 minutes) or new-onset angina (within the past two months, of at

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Figure 1. Schema of group distribution in the registry. PCI indicates percutaneous coronary intervention.
least Canadian Cardiovascular Society (CCS) Class III severity) or increasing angina (previously diagnosed angina that has become distinctly more frequent, longer in duration, or increased by one or more CCS class to at least CCS III severity); 4) non-ST-elevation MI (NSTEMI) was defined as cardiac biomarkers (creatine kinase-myocardial band [CK-MB], Troponin T or I) that exceed the upper limit of normal according to the individual hospital’s laboratory. With clinical presentation consistent or suggestive of ischemia, and an absence of electrocardiogram changes diagnostic of STEMI; 5) STEMI was defined as new or presumed new ST-segment elevation or a new bundle branch block not able to be resolved within 20 minutes and cardiac biomarkers (CK-MB, Troponin T or I) that exceed the upper limit of normal according to the individual hospital’s laboratory parameters with clinical presentation, which is consistent or suggestive of ischemia. Silent ischemia and stable angina were classified as non-ACS and unstable angina, NSTEMI and STEMI were classified as ACS. Chronic kidney disease (CKD) was defined as an estimated glomerular filtration rate (eGFR) lower than 60 mL/min/1.73 m² using the Modified Diet in Renal Disease equation. The primary outcome was cardiac death during hospitalization. The secondary outcomes were all-cause death, non-fatal MI, urgent PCI, and stroke. All-cause death was defined as any death during hospitalization after index PCI. Cardiac death was defined as any death due to a proximate cardiac cause (e.g., MI, low-output failure, fatal arrhythmia), death from an unknown cause, and all procedure-related deaths. Non-fatal MI was defined as a new occurrence of a cardiac biomarker after index PCI in

Table 1. Baseline Clinical and Angiographic Characteristics

| Demographic characteristics | Overall population | Propensity score-matched population |
|-----------------------------|--------------------|-----------------------------------|
| Pre-procedural Beta-Blocker group | Pre-procedural No-Beta-Blocker group | Absolute Standardized Difference | Pre-procedural Beta-Blocker group | Pre-procedural No-Beta-Blocker group | Absolute Standardized Difference |
| (n = 8678) | (n = 22362) | | (n = 7445) | (n = 7445) | |
| Age (years) | 66.0 ± 11.6 | 64.8 ± 12.2 | −0.101 | 66.1 ± 11.7 | 66.4 ± 11.5 | 0.027 |
| Age > 75 years | 1995 (23.0) | 4831 (21.6) | −0.033 | 1750 (23.5) | 1782 (23.9) | 0.010 |
| Male | 5968 (68.8) | 15846 (70.9) | 0.046 | 5127 (68.9) | 5111 (68.7) | −0.005 |
| Hypertension | 12487 (55.9) | 2404 (32.3) | −0.289 | 5098 (68.5) | 5287 (71.0) | 0.055 |
| Diabetes | 3262 (36.2) | 7287 (32.6) | −0.144 | 2873 (38.6) | 2892 (38.8) | 0.005 |
| Dyslipidemia | 5156 (52.1) | 7040 (31.5) | −0.426 | 3710 (49.8) | 3648 (49.0) | −0.017 |
| Chronic kidney disease | 1257 (5.6) | 619 (8.3) | −0.119 | 648 (8.7) | 648 (8.7) | 0.014 |
| Current Smoking | 6834 (30.6) | 1864 (25.0) | 0.155 | 1812 (24.3) | 1812 (24.3) | −0.016 |
| Family history of CAD | 1160 (5.3) | 437 (5.9) | 0.053 | 463 (6.2) | 463 (6.2) | 0.015 |
| Previous history of MI | 1139 (5.1) | 1099 (14.8) | −0.383 | 1030 (13.8) | 1030 (13.8) | −0.027 |
| Previous history of PCI | 2989 (13.4) | 2509 (33.7) | −0.563 | 2550 (34.5) | 2550 (34.5) | 0.012 |
| Previous CABG | 190 (0.9) | 163 (2.2) | −0.115 | 151 (2.0) | 151 (2.0) | −0.011 |
| Previous CVA | 1808 (8.1) | 661 (8.9) | −0.023 | 670 (9.0) | 670 (9.0) | 0.004 |
| Peripheral arterial disease | 416 (1.9) | 193 (2.6) | −0.053 | 210 (2.8) | 210 (2.8) | 0.014 |

Clinical diagnosis at procedure

| Unstable angina | 4773 (55.0) | 10572 (47.3) | −0.210 | 3984 (53.5) | 4274 (57.4) | 0.048 |
| NSTEMI | 2387 (27.5) | 5849 (26.2) | −0.052 | 2108 (28.3) | 1804 (24.2) | |
| STEMI | 1518 (17.5) | 5941 (26.6) | −0.263 | 1353 (18.2) | 1367 (18.4) | |

Anti-Anginal meds at procedure

| Ca-Channel-Blocker | 2001 (23.1) | 3702 (16.6) | −0.164 | 1622 (21.8) | 1778 (23.9) | 0.050 |
| Long-Acting Nitrates | 1592 (18.4) | 1410 (6.3) | −0.373 | 1141 (15.3) | 1120 (15.0) | −0.008 |
| Nicorandil | 2231 (25.7) | 1736 (7.8) | −0.495 | 1566 (21.0) | 1501 (20.2) | −0.022 |
| Trimetazidine | 1099 (12.7) | 1167 (5.2) | −0.263 | 760 (10.2) | 806 (10.8) | 0.020 |

Angiographic characteristics

| 1 vessel disease | 3132 (36.2) | 8273 (37.1) | 0.000 | 2636 (35.4) | 2706 (36.4) | 0.001 |
| 2 vessel disease | 2780 (32.2) | 6771 (30.4) | 0.000 | 2405 (32.3) | 2271 (30.5) | |
| 3 vessel disease | 2735 (31.6) | 7248 (32.5) | 0.000 | 2404 (32.3) | 2468 (33.2) | |
| Left main disease | 583 (6.7) | 1621 (7.3) | 0.000 | 528 (7.1) | 545 (7.3) | 0.009 |
| Proximal LAD lesion | 3455 (39.8) | 9623 (43.0) | 0.000 | 3042 (40.6) | 3021 (40.6) | 0.001 |
| PCI status | −0.128 | 4574 (61.4) | 4802 (64.5) | 0.063 |
| Elective PCI | 5327 (61.4) | 12317 (55.1) | 0.000 | 4574 (61.4) | 4802 (64.5) | |
| Non-elective PCI | 3351 (38.6) | 10045 (44.9) | 0.000 | 2871 (38.6) | 2643 (35.5) | |
| Arterial access site for PCI | −0.080 | 3516 (47.2) | 3422 (46.0) | −0.025 |
| Femoral | 3953 (45.6) | 11080 (49.6) | 0.000 | 4025 (54.1) | 4099 (55.1) | 0.020 |
| Radial | 4835 (55.7) | 11586 (51.8) | 0.000 | 4025 (54.1) | 4099 (55.1) | 0.020 |

Values are mean ± standard deviation or n (%). CABG indicates coronary bypass graft; CAD, coronary artery disease; CCS, Canadian Cardiovascular Society; CVA, cerebrovascular accident; LAD, left anterior descending artery; MI, myocardial infarction; and PCI, percutaneous coronary intervention.
patients with an initially negative cardiac biomarker. In patients with NSTEMI or STEMI, a rebound cardiac biomarker was considered to be non-fatal MI. Urgent PCI was defined as the repeated PCI due to PCI complications or hemodynamic instability during hospitalization after index PCI. Stroke was defined by documentation of a loss of neurological function caused by an ischemic or hemorrhagic event with residual symptoms lasting at least 24 hours after onset.

**Statistical analysis:** Baseline characteristics according to treatment with beta-blockers were described using number and percentage for categorical data and mean ± standard deviation for continuous data. Differences in characteristics were assessed using chi-square tests and two-sample Student’s t-tests. A logistic regression model was used to compare the risk of cardiac death between the groups with and without beta-blockers. Propensity scores were estimated using multiple logistic regression analysis. Full non-parsimonious models were developed and included the variables in Table I. A logistic regression analysis was also performed to evaluate reductions in outcome risk. It used pairs matched via a greedy algorithm and the nearest available pair-matching method without replacement, with a caliper of 0.1 of the propensity score. The covariate balance achieved by matching was assessed by calculating the absolute standardized differences in covariates between the two groups. An absolute standardized difference < 0.1 (10.0%) for the measured covariate suggest appropriate balance between the groups. In the propensity score-matched population, continuous variables were compared with a paired t-test, and categorical variables were compared with the McNemar’s or Bowker’s test of symmetry, as appropriate. The reduction in outcome risk was compared with the binary logistic regression model using prognostic covariates with a P-value < 0.05 used as the criterion for inclusion of variables in the multivariate models, because the combination of regression adjustments in matched samples generally produces the least biased estimate. Statistical analyses were performed with SAS version 9.2 (SAS Institute Inc., Cary, NC). All tests were two-tailed, and P < 0.05 was considered statistically significant.

**Results**

**Baseline characteristics:** In the overall included populations, 31,040 patients were presented with ACS and pre-procedural beta-blockers were prescribed in 8,678 patients (27.9%), and not in 22,362 patients (72.1%). Baseline clinical and angiographic characteristics are shown in Table I. Overall, patients in the pre-procedural beta-blocker group had multiple comorbidities. Compared with patients in the pre-procedural no-beta-blocker group, those in the pre-procedural beta-blocker group had a higher prevalence of hypertension, diabetes, dyslipidemia, CKD, previous history of MI, previous history of PCI, previous coronary artery bypass graft, unstable angina as clinical diagnosis at procedure, and elective PCI. In addition, patients in the pre-procedural beta-blocker group were older and more likely to receive other antiangiinal medications and elective PCI, but they had a lower prevalence of STEMI as a clinical diagnosis at procedure, current smoking, and non-elective PCI. After performing propensity score-matching for the entire population, a total of 7,445 matched pair pa-
patients were created. The C-statistic for the propensity score model was 0.78, and an absolute standardized difference of all variables between the pre-procedural beta-blocker group and the pre-procedural no-beta-blocker group was less than 0.1 (10.0%).

**Clinical outcomes:** In the overall included populations, the pre-procedural beta-blocker group had a significantly lower incidence of cardiac death (pre-procedural beta-blocker group versus pre-procedural no-beta-blocker group: 1.1% versus 2.3%, unadjusted odds ratio [OR]: 0.49, 95% confidence interval [CI]: 0.39-0.61, \( P < 0.01 \)), all-cause death (1.8% versus 3.2%, unadjusted OR: 0.56, 95% CI: 0.47-0.67, \( P < 0.01 \)), non-fatal MI (1.1% versus 2.1%, unadjusted OR: 0.54, 95% CI: 0.44-0.67, \( P < 0.01 \)), and stroke (0.1% versus 0.3%, unadjusted OR: 0.50, 95% CI: 0.27-0.93, \( P = 0.03 \)). The incidence of urgent PCI was similar between the pre-procedural beta-blocker group and the pre-procedural no-beta-blocker group (0.3% versus 0.3%, unadjusted OR: 1.08, 95% CI: 0.66-1.76, \( P = 0.76 \)). In propensity score-matched populations, the pre-procedural beta-blocker group still had a lower incidence of cardiac death (1.1% versus 2.0%, adjust OR: 0.52, 95% CI: 0.40-0.69, \( P < 0.01 \)), all-cause death (1.8% versus 2.8%, adjust OR: 0.62, 95% CI: 0.50-0.78, \( P < 0.01 \)), and non-fatal MI (1.2% versus 1.8%, adjust OR: 0.64, 95% CI: 0.49-0.85, \( P < 0.01 \)). There were no differences between the two groups in the rate of stroke (0.2% versus 0.2%, adjust OR: 0.75, 95% CI: 0.34-1.63, \( P = 0.46 \)) and urgent PCI (0.3% versus 0.3%, adjust OR: 1.14, 95% CI: 0.62-2.11, \( P = 0.68 \)) (Table II).

**Subgroup analysis:** In the overall included populations, the pre-procedural beta-blocker group had a significantly lower incidence of cardiac death, compared with the pre-procedural no-beta-blocker group in the STEMI subpopulation (3.1% versus 5.7%, unadjusted OR: 0.53, 95% CI: 0.89-0.72, \( P < 0.01 \)) and NSTEMI subpopulation (1.6% versus 2.4%, unadjusted OR: 0.65, 95% CI: 0.45-0.93, \( P = 0.02 \)). In propensity score-matched populations, the pre-procedural beta-blocker group still had a lower incidence of cardiac death, compared with the pre-procedural no-beta-blocker group in STEMI subpopulation (3.1% versus 6.1%, unadjusted OR: 0.49, 95% CI: 0.34-0.71, \( P < 0.01 \)) and NSTEMI subpopulation (1.5% versus 2.9%, unadjusted OR: 0.51, 95% CI: 0.33-0.79, \( P < 0.01 \)). However, in unstable angina subpopulation, the incidence of cardiac death between the pre-procedural beta-blocker group and pre-procedural no-beta-blocker group was not different in both the overall and propensity score-matched populations (Figure 2). In the analysis of the unadjusted OR for cardiac death in other subgroups, the association of a better outcome with pre-procedural beta-blocker use was consistent across various subgroups in the overall and propensity score-matched populations (Figures 3, 4).

**Discussion**

In the present study, we investigated the effect of pre-procedural beta-blocker use on clinical outcomes in...
patients with ACS who underwent PCI, using data from a nationwide multicenter registry in the Republic of Korea. The use of pre-procedural beta-blockers in ACS was associated with a lower rate of cardiac death and all-cause death in the overall population, and this result was consistent in the propensity score-matched population. The incidence of cardiac death was significantly lower in the pre-procedural beta-blocker group than the pre-procedural no-beta-blocker group, especially in patients with STEMI and NSTEMI. However, in patients with unstable angina, the incidence of cardiac death was not different between the two groups.

Beta-blockers have shown consistent improvement of clinical outcome in patients with cardiovascular disease, including survival in patients with CAD and MI or systolic HF. The presumed mechanisms of the beneficial effects of beta-blockers include a decrease in oxygen demand with the negative inotropic and chronotropic effects, decrease in left ventricular (LV) wall stress, decrease in ventricular arrhythmias, and reduced LV remodeling. Based on this evidence and hypotheses, current guidelines recommend initiation of an oral beta-blocker within 24 hours after STEMI or NSTEMI-ACS. However, the evidence of these recommendations is based on studies in the pre-PCI era, and studies focused on the use of pre-procedural beta-blockers are limited and inconsistent in the current PCI era. In a recent randomized study of patients with STEMI undergoing primary PCI, the pre-procedural effect of metoprolol in cardioprotection during an acute myocardial infarction (METOCARD-CNIC) trial showed that intravenous metoprolol administered before primary PCI reduced infarct size and preserved LV function in selected patients (anterior STEMI presenting < 6 hours from symptom onset). In another study, the early beta-blocker administration before primary PCI in patients with ST-elevation myocardial infarction (EARLY-BAMI) trial, the use of beta-blockers was not associated with a reduction in infarct size or 30 day adverse cardiac events. However, the use of beta-blockers reduced the incidence of malignant arrhythmia in the acute phase. In registry data, regarding patients with STEMI undergoing primary PCI, beta-blocker therapy was associated with a low risk of cardiac death in the STEMI and NSTEMI subpopulation during hospitalization. According to previous studies, one plausible explanation of the in-hospital mortality benefit in the confined the STEMI and NSTEMI subpopulation is the antiarrhythmic property of pre-procedural beta-blockers in the acute phase of MI. However, for patients with unstable angina in this study, pre-procedural beta-blocker therapy was not associated with a

| Age | No. of patients | No. of events | Beta-Blockers group | No Beta-Blockers group | No. of events | Odd ratio (95% CI) | P-value | P for interaction |
|-----|----------------|--------------|---------------------|------------------------|--------------|-------------------|---------|------------------|
| ≤75 years | 348/24215 | 58 (0.5) | 250 (1.7) | 0.52 (0.39-0.69) | <0.01 |
| >75 years | 299/4823 | 43 (0.9) | 219 (4.5) | 0.43 (0.30-0.66) | <0.01 |
| Sex | Male | 372/21515 | 62 (0.4) | 310 (0.4) | 0.53 (0.40-0.69) | <0.01 |
| Female | 235/9225 | 36 (0.3) | 199 (0.2) | 0.43 (0.30-0.61) | <0.01 |
| Diabeteis | yes | 253/10711 | 65 (0.3) | 207 (0.3) | 0.47 (0.34-0.65) | <0.01 |
| no | 354/20319 | 52 (0.3) | 302 (0.2) | 0.49 (0.37-0.66) | <0.01 |
| Hypertension | yes | 356/18534 | 69 (0.4) | 287 (0.3) | 0.49 (0.37-0.63) | <0.01 |
| no | 251/12499 | 62 (0.2) | 221 (0.2) | 0.51 (0.35-0.74) | <0.01 |
| Chronic kidney disease | yes | 77/2031 | 21 (0.8) | 56 (0.4) | 0.63 (0.39-1.04) | 0.07 |
| no | 530/29039 | 78 (1.0) | 452 (1.3) | 0.45 (0.29-0.67) | <0.01 |
| Prior MI | yes | 61/2624 | 22 (1.5) | 59 (3.3) | 0.44 (0.26-0.75) | <0.01 |
| no | 546/28416 | 76 (1.3) | 470 (2.3) | 0.47 (0.37-0.65) | <0.01 |
| Prior PCI | yes | 91/1914 | 29 (0.9) | 62 (2.1) | 0.43 (0.28-0.67) | <0.01 |
| no | 516/24846 | 60 (1.5) | 447 (2.3) | 0.54 (0.42-0.70) | <0.01 |
| Multivessel disease | yes | 404/9585 | 84 (1.5) | 260 (2.7) | 0.55 (0.43-0.70) | <0.01 |
| no | 143/11455 | 16 (0.5) | 127 (1.5) | 0.31 (0.18-0.53) | <0.01 |
| PCI vessel | proximal LAD | 330/13078 | 58 (1.7) | 208 (3.1) | 0.33 (0.20-0.51) | <0.01 |
| non-proximal LAD | 251/17962 | 40 (0.8) | 211 (1.7) | 0.46 (0.33-0.64) | <0.01 |

Figure 3. Comparative unadjusted odds ratio of cardiac death for subgroups in the overall population in acute coronary syndrome. CI indicates confidence interval; LAD, left anterior descending artery; MI, myocardial infarction; and PCI, percutaneous coronary intervention.
benefit in cardiac death. The insufficient effect of beta-blockers in this particular subset appears counterintuitive and may be based on multiple reasons. As previously demonstrated by the Conduit Artery Functional End Point (CAFÉ) trial investigators, pharmacologically induced bradycardia with beta-blockers leads to increased central aortic pressure with consequently worse cardiovascular outcomes. These agents are also poor at achieving optimal control of essential hypertension, resulting in a down-grade of their role as a first-line agent in current hypertension guidelines. In the subgroup analysis of the present study, the association of pre-procedural beta-blocker use with benefit of cardiac death was consistent across variable subgroups, and there was no significant interaction between pre-procedural beta-blocker and cardiac death. Although beta-blockers have currently been downgraded to secondary agents in patients with hypertension, we emphasize that beta-blockers are still recommended for patients with ACS, and it might be reasonable to consider beta-blocker in primary prevention for high-risk patients, such as patient with CAD concomitant with hypertension or diabetes, for improved mortality when those patients develop ACS. Further prospective evaluation of the preventive role of beta-blockers may be necessary for patients with various cardiovascular diseases.

Study limitations: There were some limitations to the present study. First, the study design was non-randomized, retrospective, and observational, which may have significantly affected the results owing to confounding factors. Although we performed a propensity score-matching analysis to adjust for potential confounding factors, we were not able to correct for unmeasured variables. In particular, we did not have detailed information of stability or severity in patient with acute MI, such as time of symptom onset to PCI, pre/post PCI Thrombolysis in Myocardial Infarction flow grade or Killip class on admission according to use of pre-procedural beta-blocker, the present data could have selection bias. Second, even if we use another pre-procedural or intra-procedural medication following current standard procedural guidelines, we did not have detailed information on all the medications, such as antiplatelet medications, statins, or glycoprotein IIb/IIIa receptor inhibitors. Third, in the present study, we found that pre-procedural beta-blockers had beneficial effects on cardiac death in the confined acute MI subgroup, but there was no information on the specific cause of cardiac death, such as fatal arrhythmia, HF, or various procedural complications, because of the retrospective analysis with our registry. Hence, it was difficult to determine which clinical effects of beta-blockers may lead to difference in mortality rates. Fourth, due to retrospective and
registry study design, we do not have any detailed data regarding specific types and dose of beta-blockers and prescribed duration after index PCI.

Conclusion

The use of pre-procedural beta-blockers was associated with a lower risk of in-hospital cardiac death in patients with ACS undergoing PCI and the benefit of pre-procedural beta-blocker use was remarkable in patients with acute MI. This result adds to the body of evidence that use of pre-procedural beta-blocker in patients with ACS might be reasonable.

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Disclosure

Conflicts of interest: None declared.

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