The QRS score, which was first described in 1972, is an attempt to translate subtle changes in cardiac electrical activity into information about myocardial scar location and size. The QRS score (54-criteria/32-point Selvester QRS score) is based on Q- and R-wave duration; Q, R, and S amplitude; and R/Q and R/S ratio abnormalities in leads I, II, aVL, aVF, and V1–6 from the standard 12-lead ECG. Selvester et al used it to estimate myocardial infarct size. Previous studies of QRS score have shown good correlation with anatomic findings after death, left ventricular ejection fraction, and biochemical measurements of infarct size. More recently, the QRS score has been shown to correlate well with infarct size as measured by thallium-201 perfusion imaging and by contrast-enhanced magnetic resonance imaging in patients with ST-segment elevation myocardial infarction (STEMI) undergoing reperfusion therapy. This measurement has an advantage of being feasible and is determined to achieve high specificity. However the prognostic value of the QRS score in STEMI has not been fully determined.

In this issue of the Journal, Shiomi et al evaluate the value of the QRS score in ECG at presentation in patients with STEMI undergoing primary percutaneous coronary intervention (PCI). They sought whether the QRS score is associated with infarct size, and short- and long-term mortality. They extracted data from a multicenter registry, the Coronary REvascularization Demonstrating Outcome (CREDO-Kyoto) Study in Kyoto (CREDO-Kyoto), which enrolled consecutive patients with acute myocardial infarction (AMI) who underwent coronary revascularization within 7 days of symptom-onset at 26 tertiary hospitals in Japan. A total of 2,607 patients were classified into 3 groups according to QRS score (low 0–3, intermediate 4–7, high ≥8). An incremental increase in infarct size estimated by peak creatine phosphokinase was shown as QRS score increased. Higher QRS score on presentation ECG was associated with higher rates of short- and long-term mortality. The association of high QRS score with increased mortality was most remarkably seen in patients with early (≤2 h) presentation.

The strength of this study is that the inclusion of a large number of patients to demonstrate the long-term prognostic significance of QRS score on ECG at presentation. Recently, there have been several studies that evaluated the relationship between QRS score and outcomes (Table).

In those studies, however, the QRS score on ECG at hospital discharge was measured to obtain the results. The present study demonstrated that QRS score on ECG at presentation, when the infarction process was still ongoing, could predict infarct size and death. Because of its feasibility, QRS score may offer a method of early risk stratifica-

### Table. Studies of the Relationship Between QRS Score and Prognosis in Patients With CAD

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Target</th>
<th>n</th>
<th>Observation period (months)</th>
<th>Timing of QRS score calculation</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xie et al⁷</td>
<td>2017</td>
<td>CTO</td>
<td>474</td>
<td>34</td>
<td>At discharge</td>
<td>MACCEs</td>
</tr>
<tr>
<td>Tjandrawidjaja et al⁸ (APEX-AMI trial)</td>
<td>2010</td>
<td>STEMI</td>
<td>5,745</td>
<td>3</td>
<td>At discharge</td>
<td>Death, CHF, shock</td>
</tr>
<tr>
<td>Kalogeropoulos et al⁹</td>
<td>2008</td>
<td>STEMI</td>
<td>100</td>
<td>3</td>
<td>At discharge</td>
<td>Death and readmission for heart failure</td>
</tr>
<tr>
<td>Barbagelata et al¹⁰</td>
<td>2004</td>
<td>AMI</td>
<td>285</td>
<td>12</td>
<td>At discharge</td>
<td>Mortality, resource use, and quality-of-life measures</td>
</tr>
<tr>
<td>Watanabe et al¹¹</td>
<td>2015</td>
<td>STEMI</td>
<td>62</td>
<td>0.3</td>
<td>On admission after PCI</td>
<td>Presence of microvascular obstruction</td>
</tr>
<tr>
<td>Jones et al¹²</td>
<td>1990</td>
<td>STEMI</td>
<td>1,915</td>
<td>60</td>
<td>72h after PCI</td>
<td>Survival rate</td>
</tr>
</tbody>
</table>

AMI, acute myocardial infarction; CAD, coronary artery disease; CTO, chronic total occlusion; MACCEs, major adverse cardiac and cerebral events; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction.

The opinions expressed in this article are not necessarily those of the editors or of the Japanese Circulation Society.

Received June 8, 2017; accepted June 13, 2017; released online July 4, 2017

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**QRS Score**

— Possibilities and Limitations —

Jun Kishihara, MD, PhD; Junya Ako, MD, PhD
tion of STEMI patients. Although various cardiac imaging techniques, including technetium-99 m sestamibi single-photon emission computed tomographic imaging and magnetic resonance imaging, are considered more precise in quantifying infarct size, these methods are not readily available or feasible in the acute setting. Although serial measurements of biomarkers of myocardial necrosis may be cost effective, peak values can be missed because of rapid washout after the “abruptness” of PCI-based reperfusion. Because of the known large variation in the speed and magnitude of reflow after reperfusion therapy and its effect on biomarker kinetics, meaningful correlations between areas under the curve or peak values and infarct size are difficult. Considering the importance of predicting prognosis in MI, the results of this study should be tested in another prospective cohort.

Several limitations must be noted. Despite its demonstrated value, clinical application of this QRS score has been significantly limited by several issues such as training necessary for accurate application, the time required to score an individual ECG, and inconsistent accuracy obtained by human scorers. Left or right bundle branch block and ventricular-paced ECG were excluded from this analysis as confounders of calculating the QRS score. They were considered confounding factors that prevented infarction evaluation via QRS score.

Nonetheless, the QRS score is an attractive and potentially cost-effective method of stratifying patient outcomes. The authors demonstrate the long-term prognostic significance of QRS score on presentation ECG. Risk stratification has always been stressed as an important step in identifying potential targets for investigational therapies including distal protection device, hypothermia, and left ventricular assist device. The QRS score might be useful for risk stratification, potentially affecting future study designs. Further studies are needed to validate the results of this clinically attractive scoring system.

Disclosures
The authors have no conflicts of interest to disclose.

References