EDITORIAL
DOI 10.4070/kcj.2011.41.7.354

Print ISSN 1738-5520 / On-line ISSN 1738-5555

Open Access

Prognostic Impact of Early ST-Segment Resolution and Biochemical Markers in Patients With ST-Elevation Myocardial Infarction

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Considerable variability exists for the reported mortality risk among patients with ST-elevation myocardial infarction (STEMI) and who are treated with primary percutaneous coronary intervention (PCI). The diversity in the clinical outcomes for these patients challenges the physician at each step: risk stratification, planning the treatment and monitoring the response to PCI. In this regard, the current guidelines for the treatment of patients with acute coronary syndrome (ACS) recommend risk stratification using a variety of clinical variables. Clinical variables such as biomarkers, electrocardiography (ECG), and the imaging modalities have been studied for whether these variables may improve the risk assessment and clinical care. The standard 12-lead ECG has been used as the single most important diagnostic tool for the evaluation of ACS. Measurement via ECG is very useful and informative for determining the quality of reperfusion in patients with acute STEMI. The degree of ST segment deviation also confers prognostic information.[1] Since it was first documented in 1971 in an animal study that the magnitude of ST segment elevation was well correlated well with depressed myocardial creatine kinase activity as well as myocardial necrosis,[2] the degree of ST segment elevation has been used as an index of the severity of myocardial ischemic injury. Successful recanalization of the epicardial coronary arteries by PCI does not ensure microvascular reperfusion, which is strongly correlated with the cardiovascular outcome. The ST-segment changes reflect the status of myocardial tissue perfusion, and so this may provide prognostic information beyond that suggested by a coronary angiogram.[3] The consistent relationship between the degree of ST resolution and the risk for death and congestive heart failure in patients who are treated with fibrinolytic therapy has been previously reported.[4][5]

Woo et al.[6] evaluated the resolution of the sum of ST-segment elevation (sum STR) 60 minutes after primary PCI as well as the biochemical markers to determine the prognostic value of these indices in patients with STEMI. That study showed that an incomplete sum STR is associated with a poor Killip class, delayed PCI, a decreased ejection fraction and increased baseline biomarkers, including high sensitivity C-reactive protein (hs-CRP), troponin I (TnI) and N-terminal pro-B-type natriuretic peptide (NT-proPNP). In that study, the degree of the sum STR provided a prognostic factor for major adverse cardiac events (MACEs) within 6 months, which is consistent with previous observation.[5] Furthermore, the addition of biochemical markers such as TnI, NT-proBNP and hsCRP to the sum STR improved the prognostic value. That study reappraised the importance of the ST resolution for predicting MACEs and it emphasized the enhanced predictive power by combining additional biomarkers. The sum STR has been used as a conventional method, yet measuring the ST elevations from all the leads is somewhat time consuming. Schröder et al.[5] suggested 2 other methods that are superior to the conventional sum STR in terms of the predictive accuracy and simplicity (Fig. 1): 1) the ST-segment deviation resolution in the single lead that shows the maximum

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• The author has no financial conflicts of interest.

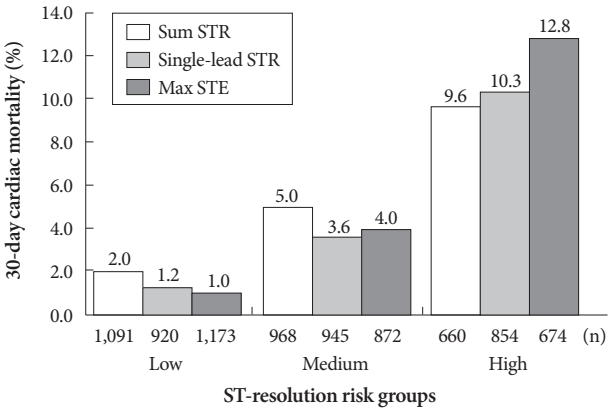

Fig. 1. The thirty-day cardiac mortality rates by the ST resolution risk groups with the ECG recorded at 90 minutes after onset of STEMI in 2,719 patients of the InTIME II Study. STR: resolution of ST-segment elevation, max STE: the maximum ST-segment deviation in a single lead.[5]

deviation (single-lead STR) and 2) the existing ST-segment deviation in the single ECG lead with the maximum deviation at a given time point (max STE).

Woo et al.[6] determined that hs-CRP is an independent predictor of MACEs after STEMI, whereas other biomarkers such as TnI and NT-proBNP were not as significant independent predictors, as assessed by multivariate analysis. Elevated CRP is a nonspecific marker of inflammation, and this has been associated with poor outcomes in patients with ACS.[7] There is only limited data on this and it is restricted to patients with STEMI. For the patients with Q-wave acute myocardial infarction in 1 cohort study, increased CRP was associated with complications of acute MI such as left ventricular aneurysm, aggravated heart failure and cardiac death.[8] On the other hand, several studies have shown that hs-CRP is an independent predictor of the short- and/or long-term outcome among patients with Non-ST elevation acute coronary syndrome.[7] This data may suggest two possibilities. First, elevation of CRP during ACS is probably an intensification of the inflammatory process and this can contribute to complications of vulnerable plaque. Second, elevated CRP could be a consequence of the inflammation in response of myocardial necrosis. However, the precise relationship between CRP and the risk in ACS has not yet been conclusively established.

Cardiac troponin and natriuretic peptide have been assessed for their usage in clinical care. Increased cardiac troponin is central to the definition of MI, and an elevated troponin level on admission is associated with worse outcomes in patients with STEMI.[1] Natriuretic peptides are released from the myocardium in response to stress, and they are increased in a variety of cardiovascular diseases, including heart failure. Elevated levels of natriuretic peptide are strongly associated with the clinical outcomes in patients with STEMI.[9] However, there are no clear clinical implications of how an increased natriuretic peptide level should guide specific treatment in patients with ACS.

In conclusion, analysis of ST-segment resolution as seen on standard 12-lead ECG is a rapid, efficient way to assess the quality of reperfusion and so this provides prognostic information for patients with ACS. Biomarkers such as hsCRP and TnI may confer additional prognostic information, to some extent, for these patients. However, assessing the levels of TnI and natriuretic peptides in ACS patients is still not certain with regard to the clinical decision making.

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