Usefulness of Peak Systolic Strain Measurement by Automated Function Imaging in the Prediction of Coronary Perfusion in Patients with Acute Myocardial Infarction

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Background/Aims: The usefulness of global longitudinal peak systolic strain (GLPSS) measurement by automated function imaging (AFI) in the prediction of perfusion status of infarct-related artery (IRA) before percutaneous coronary intervention (PCI) was evaluated.

Methods: Sixty-nine patients with acute myocardial infarction (AMI) who underwent successful primary PCI were divided into two groups; the patients with occlusion of IRA (Group I, 41 patients, 63.0 ± 14.9 years of age, 31 males) versus the patients with patent IRA (Group II, 28 patients, 63.8 ± 11.2 years of age, 15 males). GLPSS by AFI and wall-motion score index (WMSI) were analyzed in both groups.

Results: GLPSS was significantly decreased in Group I compared with Group II (-11.2 ± 3.7 vs. -14.1 ± 4.7%, \(p = 0.005\)), but WMSI (1.49 ± 0.28 vs. 1.35 ± 0.32, \(p = 0.062\)) did not differ between groups. GLPSS of infarct segments was significantly lower (-3.7 ± 5.4 vs. -11.4 ± 4.8%, \(p < 0.001\)), and WMSI of infarct segments was significantly higher (2.13 ± 0.57 vs. 1.66 ± 0.57, \(p = 0.001\)) in Group I compared with Group II. By receiver operation curve analysis, the area under the curve to predict IRA occlusion was 0.850 in GLPSS of infarct segments and 0.719 in WMSI of infarct segments. The optimal cut-off value to predict IRA occlusion was -9.4% in GLPSS of infarct segments (sensitivity, 85.4%; specificity, 67.9%) and 1.68 in WMSI of infarct segments (sensitivity, 78.0%; specificity, 60.7%).

Conclusions: The present study suggested that GLPSS measured by AFI is a more sensitive predictor of IRA occlusion than is WMSI before PCI. Routine measurement of GLPSS by AFI can be a very useful tool in risk stratification of AMI. (Korean J Intern Med 2010;25:260-268)

Keywords: Strain; Myocardial infarction; Myocardial reperfusion

INTRODUCTION

The perfusion status of infarct-related artery (IRA) is a significant predictor of infarct size and clinical outcome and is thus important in the risk stratification of acute myocardial infarction (AMI) [1-4]. Previous studies have shown that patients with spontaneous reperfusion of IRA show better clinical outcomes and have smaller infarcts [5-9].

Strain and strain-rate imaging by a 2-dimensional (2D) speckle tracking method is a novel echocardiographic modality to evaluate regional and global myocardial function, and is relatively free from the angle dependency and frame-rate limitation of tissue Doppler imaging (TDI) [10-13]. Automated function imaging (AFI) is a newly introduced computerized 2D-based strain measurement...
tool to highlight potential wall-motion abnormalities. 2D strain analysis allows more accurate evaluation of regional and global myocardial function, infarct size, viability of the infarcted myocardium, and subtle changes related to myocardial ischemia than do conventional 2D echocardiographic methods, such as wall-motion score (WMS) or wall-motion score index (WMSI), in patients with AMI. Therefore, 2D strain analysis provides useful information not only in the diagnosis of AMI, but also in the risk stratification and prognostication of future clinical outcomes.

Although attempts have been made to detect coronary reperfusion before percutaneous coronary intervention (PCI) by analyzing myocardial integrated backscatter [14] and contrast echocardiography [15], data are lacking on the relationship between the perfusion status of IRA before PCI and global longitudinal peak systolic strain (GLPSS) as measured by this novel 2D strain analysis in patients with AMI. Therefore, the aim of this study was to investigate the usefulness of GLPSS measurement by AFI compared with WMSI in predicting coronary perfusion in patients with AMI.

METHODS

Study subjects
From October 2006 to September 2007, a total of 76 patients with AMI who underwent successful primary PCI within 12 hours from the onset of AMI for single vessel disease and who did not meet the exclusion criteria were initially enrolled. However, six patients with poor image quality and one patient who withdrew informed consent after image acquisition were excluded. Therefore, a total of 69 patients were included for analysis.

The study protocol was approved by the Institutional Review Board, and informed consent was obtained from each patient. Exclusion criteria were 1) a history of previous myocardial infarction (MI) or PCI, 2) significant multi-vessel disease, 3) cardiogenic shock at presentation, 4) thrombolytic therapy before admission, 5) atrial fibrillation/flutter or significant ventricular arrhythmias, 6) significant valvular stenosis-insufficiency, and 7) patients who could not perform the echocardiographic examination before PCI or within 1 hour after primary PCI.

Echocardiographic examination
Echocardiographic examinations were performed before PCI or within 1 hour following successful PCI to minimize the impacts of PCI. Routine echocardiographic examinations were performed by the recommendation of the current guidelines. Echocardiographic images from the various echocardiographic windows, including three apical views, were obtained using digital ultrasound equipment (Vivid 7, GE Vingmed Ultrasound, Horten, Norway). Digital cine loops were obtained for subsequent off-line analysis. All data were analyzed by a computerized off-line software package (EchoPAC PC 6.0.0, GE Medical Systems, Horten, Norway).

Regional wall motion of the left ventricle (LV) was evaluated by calculating WMS or WMSI of the LV as suggested by the American Society of Echocardiography [16]. A numeric scoring system was adopted for each segment based on the contractile status (normal, 1; hypokinesia, 2; akinesia, 3; dyskinesia, 4; aneurysm, 5). The WMSI was calculated by dividing the sum of the WMS by the number of visualized segments, and the WMSI of the IRA was calculated by dividing the sum of the WMS of the IRA segments by the number of IRA segments. A representative example of the measurement of the GLPSS by AFI is shown in Fig. 1.

Assessment of coronary perfusion
Coronary angiography and PCI were done as soon as possible after confirming a diagnosis of AMI. The IRA was determined by comparing electrocardiography, echocar-