A Novel Program to Accurately Quantify Infarction Volume by $^{99m}$Tc MIBI SPECT, and Its Application for Re-Analyzing the Effect of Erythropoietin Administration in Patients With Acute Myocardial Infarction – A Randomized Controlled Pilot Trial of the EPO/AMI-I Study –

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**Background:** This study aimed to apply a software to calculate myocardial infarction (MI) volume by single-photon emission computed tomography.

**Methods and Results:** The cardioVol software has been developed to reconstruct 3D figures from sequential short axis images. We re-analyzed the data from the EPO/AMI-I Study. The MI volume at baseline correlated with maximum creatine kinase. The MI volume significantly decreased during the 6-month follow up in the erythropoietin (EPO) group, but not in the control group. The decrements of MI volume in the EPO group were significantly larger than those in the control group.

**Conclusions:** The efficacy of EPO was further confirmed by the software. (*Circ J* 2010; 74: 2741–2743)

**Key Words:** Acute myocardial infarction; Erythropoietin; Single-photon emission computed tomography

**We** previously reported the results from a randomized controlled pilot trial of the EPO/AMI-I study. In the study, patients admitted with acute myocardial infarction (AMI) had all undergone successful percutaneous coronary intervention (PCI). Thirty-six patients were randomly assigned to 2 groups (control = 16, erythropoietin (EPO)=20), and were intravenously administered with 12,000 IU of EPO or with saline after PCI. The primary endpoints were the difference between the acute phase and chronic phase (6 months after the attack) regarding left ventricular (LV) function as measured by electrocardiogram-gated single-photon emission computed tomography (SPECT). Although LV ejection fraction (LVEF) significantly increased in the EPO group (51.0±19.6 to 58.5±15.0%, P=0.0238), and it did not in the control group, there was no significant difference of myocardial infarction (MI) size between the 2 groups.

In the study, we performed electrocardiogram-gated $^{99m}$Tc MIBI SPECT 4 days after PCI as baseline and at 6-month follow-up. A polar map (bull’s eye) was constructed from the non-gated SPECT image to assess the severity of myocardial perfusion abnormalities, and the infarct area was calculated by cardioBull software (FUJIFILM RI Pharma, Tokyo, Japan). Regional uptake was assessed by applying a 17-segment model of the left ventricle according to the standardized myocardial segmentation by the Cardiac Imaging Committee of the Council on Clinical Cardiology of the American Heart Association. Defects at less than the threshold of 60% of peak counts were identified as an infarcted myocardium, and the infarct area was expressed as a percentage of the entire left ventricle involved in polar mapping.

Standard procedures using polar mapping semiquantified the infarcted myocardium by a projection of myocardial segments, and the data was expressed as % MI area, but not real MI volume. We then tried to develop novel software to logically quantify the volume of the LV wall and infarcted myocardium by 3D reconstruction of short axes SPECT images.
Methods

Using the cardioVol software as shown in Figure 1, pericar-dium- and endocardium-surfaces are recognized by the automatic tracer program of pFAST2 software (FUJIFILM RI Pharma, Tokyo, Japan), the left ventricle wall is expressed as a mask, and an image of SPECT is superimposed onto the mask. The previously established computerized algorithm combining count-based and image-based methods to define the outline extraction is written elsewhere. The MI area is defined as the territory of pixels <60% of maximal RI accumulation in the sections, and finally LV wall volume and MI volume are calculated by 3D reconstruction of the mask and MI area of each short axis, respectively. We applied the cardioVol software to re-analyze SPECT data from the EPO/AMI-I pilot study.

Results

As shown in Figure 2, MI volume at baseline correlated with maximum creatine kinase in the acute phase. The MI volume significantly decreased during the 6-month follow up in the EPO group (MI volume at 0 months: 43.2±34.0 cm³, 6 months: 30.7±29.7 cm³, P=0.0203, Δ: -12.9±19.7 cm³), but not in the control group (0 months: 42.1±30.8 cm³, 6 months: 43.0±35.3 cm³, P=0.9279, Δ: 0.9±12.0 cm³). The decrements of MI volume in the EPO group were significantly larger than those in the control group (P=0.0314). Relative MI volume (%) also significantly decreased during the 6-month follow up in the EPO group but not in the control group. The LV wall volume seemed to decrease during the 6-month follow up in the EPO group possibly via preventing late remodeling.

Discussion

Functional evaluation of coronary artery disease by myocardial perfusion SPECT predicts patients’ short- and long-term prognosis, and our previous analyses disclosed that EPO administration improved LVEF. The efficacy of EPO administration for AMI patients was further confirmed by application of the cardioVol software. This novel software needs to be validated using a golden standard, and to be further applied for following clinical studies of AMI. We will carry out a comparative analysis of SPECT and magnetic resonance imaging in patients with AMI.

Disclosures

None.

References