Reverse-remodeling after coronary artery bypass grafting in ischemic cardiomyopathy: assessment of myocardial viability by delayed-enhanced magnetic resonance imaging can help cardiac surgeons

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Abstract

Preoperative delayed-enhanced magnetic resonance imaging (DE-MRI) was performed to estimate myocardial viability in a 57-year-old man with ischemic cardiomyopathy in order to decide the best course of treatment. The patient was diagnosed as having congestive heart failure with triple-vessel involvement (ejection fraction of 7%, end-diastolic volume index of 160 ml/m², end-systolic volume index of 148 ml/m²). 99mTc-sestamibi single-photon emission computed tomography revealed severe reduction of the uptake at both stress and resting phases in the anterior, lateral, and inferior segments. However, DE-MRI demonstrated transmural hyperenhancement to be <25% within the whole ventricular wall, implying that, though there was extensive subendocardial myocardial infarction, there was substantial viable myocardium. Therefore, with the expectation that functional recovery was possible with coronary revascularization alone, we performed a complete revascularization with off-pump coronary artery bypass grafting. Six months after the operation, catheterization demonstrated dramatic improvement in ventricular function, with the ejection fraction having increased to 36%. This case suggests that preoperative assessment of myocardial viability by DE-MRI could help cardiac surgeons to choose the best treatment for patients with ischemic cardiomyopathy.

Keywords: Ischemic cardiomyopathy; Reverse-remodeling; Delayed-enhanced magnetic resonance imaging; Myocardial viability; Subendocardial infarction

1. Case

A 57-year-old man was admitted to a local hospital with congestive heart failure. Coronary angiography revealed triple-vessel involvement with chronic total obstruction of the proximal portion of the right coronary artery, 90% stenosis of the proximal portion of the left anterior descending coronary artery and chronic total obstruction of the terminal left posterolateral branch. Left ventriculography demonstrated an extensive akinetic area and an ejection fraction (EF) of 7%, end-diastolic volume index (EDVI) of 160 ml/m², and end-systolic volume index (ESVI) of 148 ml/m². Using a Swan-Gantz catheter, the systemic pulmonary artery pressure of 46 mmHg, and the cardiac index of 1.8 l/min/m². 99mTc-sestamibi single-photon emission computed tomography (SPECT) revealed severe reduction of the uptake at both stress and resting phases in the anterior, lateral and inferior segments (Fig. 1a,b). However, delayed-enhanced magnetic resonance imaging (DE-MRI, Philips Gyroscan 1.5 tesla) revealed transmural hyperenhancement to be <25% within the whole ventricular wall, implying that, though there was extensive subendocardial myocardial infarction, there was substantial viable myocardium (Fig. 1c,d). Serum brain natriuretic peptide (BNP) level was 1093 pg/ml preoperatively. On the basis of the MRI assessments, we considered that this severe reduction in ventricular contraction had resulted from an extensive hibernation and, therefore, strongly expected that the function might be much improved by coronary revascularization alone.

We performed a complete revascularization with an off-pump technique: right internal thoracic artery to the left descending coronary artery, left internal thoracic artery to the terminal left posterolateral branch and sequentially to the right posterolateral branch, and gastroepiploic artery to the postero-descending coronary artery. No scar formation was directly seen on the surface of the left ventricle. The postoperative course was uneventful, and the patient was discharged ten days after the operation. Early postoperative echocardiography and cine-MRI did not demonstrate any remarkable changes in ventricular function.

However, six months after the operation, catheterization demonstrated that all the grafts were patent and that ventricular function had dramatically improved, with EF being 36%, EDVI 127 ml/m², ESVI 83 ml/m² and the cardiac index 2.6 l/min/m² (Fig. 2). The New York Heart Association (NYHA) functional class had also improved to I. Cine-MRI showed significant improvement in the anterior and lateral...
wall motion and wall thickening. Serum BNP level had fallen to 260 pg/ml. Fourteen months after the operation, the patient is fine, and is NYHA functional class I.

2. Discussion

Regarding patients with a large left ventricle (LV) due to ischemic cardiomyopathy, deciding whether to perform coronary artery bypass grafting (CABG) alone or with surgical ventricular restoration is important. To make the decision, accurate assessment of myocardial viability is necessary to judge whether the regional wall motion will be improved after revascularization.

For determining myocardial viability, several imaging methods are now available, including stress echocardiography, SPECT, positron emission tomography, and MRI. Of these, DE-MRI is the only modality that can reliably demonstrate with a higher spatial resolution the transmural extent of the infarcted myocardium within asynergic left ventricular walls [1, 2]. Wagner and colleagues suggested that 47% of the areas having subendocardial infarction (transmural extent <50%) obtained by DE-MRI showed ‘defect’ at resting 201TI SPECT [3]. In the present case, the anterior, lateral and inferior segments were initially considered ‘non-viable’. However, DE-MRI showed the subendocardial infarction with the transmural extent <25% in the same segments (arrow).

References


