A 72-year-old woman was admitted with chest pain. On ECG, abnormal Q wave was noted in leads II, III, aVF, V1, and V2. Coronary angiography revealed occluded right and left anterior descending coronary arteries. Collateral vessels were observed from the left circumflex coronary artery to the right coronary artery.

Dynamic first-pass magnetic resonance (MR) perfusion imaging was performed in a resting condition, using 0.075 mmol/kg gadodiamide (Gd DTPA-BMA) and saturation-recovery gradient echo sequence. Fifteen minutes after a 0.15 mmol/kg dose of Gd DTPA-BMA was injected, delayed-enhanced MR images were acquired through the use of an inversion-recovery segmented gradient echo sequence. Additionally, cine MR images were acquired with the use of a segmented true fast imaging with steady-state precession sequence. Perfusion deficit was noted in the subendocardial layer of septal and inferior walls (Figure 1A and Figure 2A; Movie I and Movie II), whereas no evident delayed hyper-enhancement was observed (Figure 1B and Figure 2B). This suggests that severe myocardial hypoperfusion in a resting condition is present without myocardial infarction. By thallium-201 single-photon emission tomography at rest (Figure 1C and Figure 2C) and F-18 fluorodeoxyglucose (FDG) positron emission tomography (PET) (Figure 1D and Figure 2D), enhanced FDG uptake was clearly noted in the hypoperfused segments. Thus, the hypoperfused myocardium was suggested to be the ischemic but viable myocardium. In cine MRI, wall thinning and a marked decrease in wall thickening was observed in these segments (Figure 1E and 1F and Figure 2E and 2F; Movie III, left, and Movie IV, left). Her left ventricular ejection fraction was 42%. Based on these results, the left internal thoracic artery was grafted onto the left anterior descending artery and the left gastroepiploic artery onto the posterior descending artery. One month after the bypass operation, significantly improved wall thickness and wall thickening was observed in the septal and inferior walls by cine MRI (Figure 1G and 1H, and Figure 2G and 2H; Movie III, right, and Movie IV, right). Left ventricular ejection fraction increased to 56%.

Rahimtoola first proposed the pathophysiological concept of myocardial hibernation to characterize a situation of a prolonged subacute or chronic state of myocardial ischemia in which myocardial contractility, ventricular function, and metabolism are changed to match the reduced blood supply whereby myocardial necrosis is prevented, and the myocardium is capable of returning to normal or near-normal function on restoration of an adequate blood supply. This case is considered a typical example of myocardial hibernation. The pathophysiological status of the hibernating myocardium has been demonstrated by multimodality imaging.

Reference
Figure 1. Short axis. A, MR first-pass perfusion image at rest; B, delayed-enhanced MR image; C, thallium image at rest; D, FDG PET image. E and F, end-diastolic and end-systolic images of cine MRI from the preoperative MR scan; G and H, those from the postoperative MR scan. Resting subendocardial ischemia (A, black arrows) is noted in the septal and inferior walls without late hyperenhancement (B). Hypoperfusion is also noted on resting thallium single-photon emission tomography in the septal and inferior walls (C, white arrows). In these regions, enhanced FDG uptake is observed (D, white arrows), suggesting the ischemic but viable myocardium. Note the myocardial wall thinning in the septal and inferior walls (E, F) and the reduced myocardial thickening in these regions (F, black arrows). After coronary artery bypass grafting, the myocardial wall thickness and systolic wall thickening improves markedly in these segments (G, H).

Figure 2. Vertical long axis. A, MR first-pass perfusion image at rest; B, delayed-enhanced MR image; C, thallium image at rest; D, FDG PET image. E and F, end-diastolic and end-systolic images of cine MRI from the preoperative MR scan; G and H, those from the postoperative MR scan. Resting subendocardial ischemia (A, black arrows) is noted in the septal wall without late hyperenhancement (B). Hypoperfusion is also noted on resting thallium single-photon emission tomography in the septal wall (C, white arrows). In this region, enhanced FDG uptake is observed (D, white arrows), suggesting the ischemic but viable myocardium. Note the myocardial wall thinning in the septal wall (E, F) and the reduced myocardial thickening in this region (F, black arrows). After coronary artery bypass grafting, the myocardial wall thickness and systolic wall thickening improves markedly in this segment (G, H).
Hibernating Myocardium Identified by Cardiovascular Magnetic Resonance and Positron Emission Tomography

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