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Clinical usefulness of ECG-gated ^{18}F-FDG PET combined with ^{99m}Tc-MIBI gated SPECT for evaluating myocardial viability and function

Yohei YAMAKAWA,* Nobukazu TAKAHASHI,** Toshiyuki ISHIKAWA,* Kazuaki UCHINO,* Yasuyuki MOCHIDA,* Toshiaki EBINA,* Tsukasa KOBAYASHI,* Kohei MATSUSHITA,* Katsumi MATSUMOTO,* Noriko KAWASAKI,* Mie SHIMURA,* Yasuo OHKUSU,* Shinichi SUMITA,* Kazuo KIMURA,* Tomio INOUE** and Satoshi UMEMURA*

*Second Department of Internal Medicine, Yokohama City University School of Medicine
**Department of Radiology, Yokohama City University School of Medicine

Objectives: This study sought to evaluate an imaging approach using gated ^{99m}Tc-MIBI (MIBI) SPECT and gated ^{18}F-FDG (FDG) PET for assessment of myocardial viability and cardiac function. ***Methods:*** Forty-eight patients (38 men, mean age 68.1 ± 9.6 years) underwent ECG-gated FDG PET and MIBI SPECT within a week. The baseline diagnoses were coronary artery disease (31), mitral regurgitation (1), paroxysmal arrhythmia (10), and dilated cardiomyopathy (6). The gated FDG PET data were analyzed using pFAST software, and the gated MIBI SPECT data were analyzed using QGS software. Fifteen patients were diagnosed with myocardial infarction, and follow-up study was performed to assess the functional outcome four months later. An improvement in LVEF of >5% was defined as significant. The LV myocardium was divided into 17 segments, and regional defect scores were visually assessed using a 4-point scale for each segment (0 = normal, 1 = mildly reduced, 2 = moderately reduced, 3 = absent). A segment with a greater defect score on MIBI SPECT than on FDG PET was defined as a mismatch. The patients were divided into two groups: those with at least two mismatched segments (MM-group), and those with none or one (M-group). ***Results:*** LVEF, EDV and ESV measured by gated FDG PET were highly correlated with those obtained by gated MIBI SPECT ($r = 0.848$, 0.855 and 0.911, $p < 0.0001$, respectively). The mean values of LVEF did not differ significantly, but EDV and ESV obtained by gated FDG PET were significantly grater than those obtained by gated MIBI SPECT ($p < 0.0001$). In 15 patients diagnosed with myocardial infarction, a significant association ($p < 0.05$) was found between the relative uptake of FDG PET and MIBI SPECT and the functional outcome 4 months later. Global LV function improved in 6 of the 8 patients showing mismatch but in only 1 of the 7 patients with matched defects, resulting in a sensitivity of 86% and specificity of 75%. The overall accuracy to predict global functional outcome was high (80%). ***Conclusion:*** This imaging approach allows accurate evaluation of myocardial viability. Furthermore, the high correlations of gated FDG PET and gated MIBI SPECT measurements hold promise for the assessment of left ventricular function using gated FDG PET.

Key words: gated FDG PET, gated MIBI SPECT, myocardial viability, myocardial function

INTRODUCTION

EVEN SEVERELY dyssynergic myocardium in patients with chronic coronary artery disease (CAD) may show functional improvement after revascularization.[1,2] Therefore, accurate identification of myocardium with such reversible ischemia, "viability assessment," has important

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For reprint contact: Yohei Yamakawa, M.D., Second Department of Internal Medicine, Yokohama City University School of Medicine, 3–9 Fukuura, Kanazawa-ku, Yokohama 236–0004, JAPAN.
E-mail: yama9433@tokai.or.jp

clinical implications, especially in patients being considered for interventional therapy.[3,4] Several studies have shown that ^{99m}Tc-methoxy-isobutylisonitrile (^{99m}Tc-MIBI) myocardial perfusion single photon emission tomography (SPECT) and ^{18}F-fluoro-2-deoxy-D-glucose (^{18}F-FDG) myocardial metabolic perfusion positron emission tomography (PET) are good methods to identify viable myocardium, as well as using ^{13}N-ammonia PET and ^{18}F-FDG metabolic PET, in the evaluation of myocardial viability and indication for revascularization in patients with chronic coronary artery disease.[5–9] Several studies have shown that cardiac function, left ventricular (LV) volume, and myocardial blood flow (MBF) are important factors for evaluating the prognosis of patients with cardiovascular disease.[10–13] Gated myocardial perfusion SPECT has been used to calculate ejection fraction (EF) and end-diastolic volume (EDV), and its measurements correlate highly with those obtained by conventional methods.[14–25] Several kinds of gated SPECT software for quantification have been developed and applied to clinical practice. These include Quantitative Gated SPECT (QGS, Cedars-Sinai Medical Center, Los Angeles, CA)[14] and Perfusion and Functional Analysis for Gated SPECT (pFAST; Sapporo Medical University, Sapporo, Japan).[21] These software programs have shown a high correlation between EF or EDV and the results of gated blood-pool (GBP) study, and the results obtained using pFAST correlated best with the results of GBP study.[26] The aim of the present study was to evaluate an imaging approach using gated ^{99m}Tc-MIBI SPECT and gated ^{18}F-FDG PET for simultaneous assessment of myocardial viability and left ventricular function in patients with coronary artery disease.

MATERIALS AND METHODS

PET Procedures

^{18}F-FDG PET using a SHIMADZU-SET 2400W PET scanner (HEADTOME V, Shimadzu Corp., Kyoto, Japan) was performed to obtain data on myocardial glucose metabolism under glucose loading. First, 75 g glucose was given orally to each patient 1 hour before injection of FDG. FDG (370 MBq) was injected 1 hr prior to PET acquisition. Prior to obtaining gated emission images using PET, simultaneous emission and transmission data were acquired for 15 minutes, and the transmission data were used to correct photon attenuation. Transaxial, short axial and vertical long axial images were reconstructed using summed gated data. The serum glucose level reached 120–160 mg/m*l*. Images were collected in 128 × 128 matrixes and then reconstructed with a Butterworth filter and a Ramp filter. Transaxial images were reconstructed using the Butterworth-filtered backprojection method (order, 2; cutoff frequency, 0.4). Horizontal long-axial, vertical long-axial, and short-axial images were obtained. Images were gated at 12 frames per

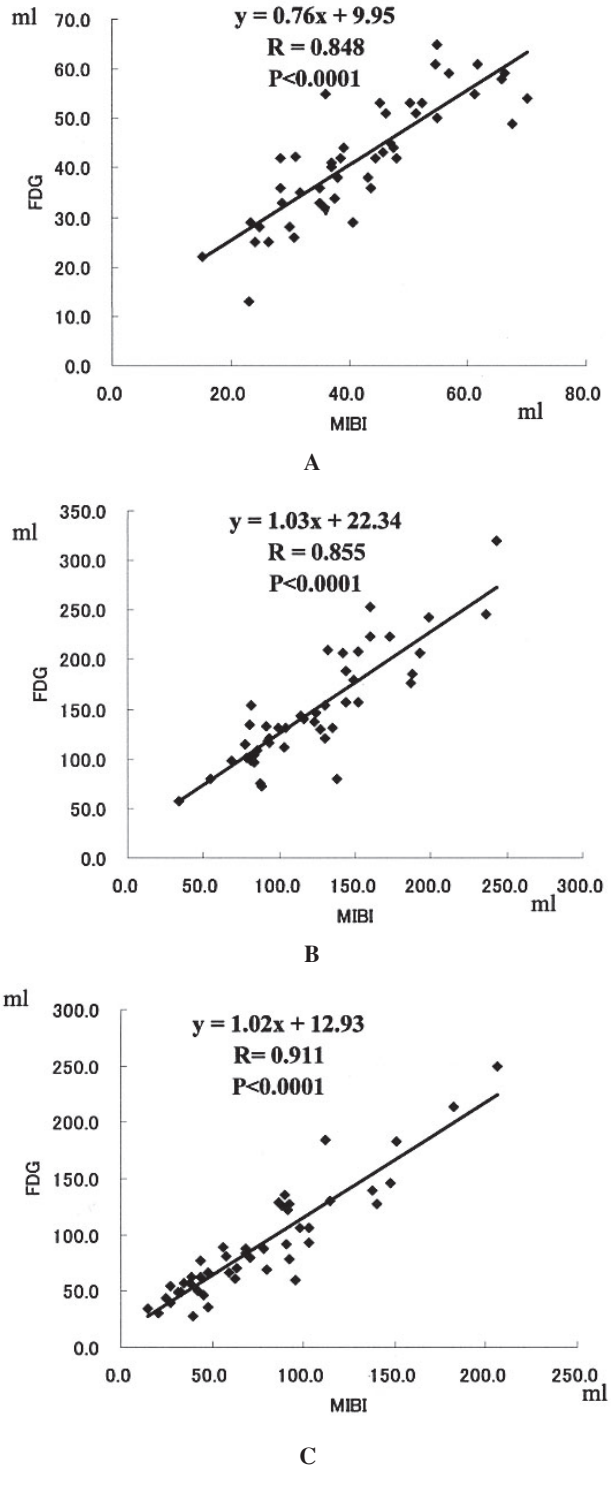


Fig. 1 A: Correlation of LVEF from ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET. B: Correlation of EDV from ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET. C: Correlation of ESV from ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET. LVEF, EDV and ESV were determined by gated ^{99m}Tc-MIBI SPECT with QGS and by gated ^{18}F-FDG PET with pFAST. LVEF = left ventricular ejection fraction, EDV = end-diastolic volume, ESV = end-systolic volume.

Table 1 Baseline characteristics of 15 patients with myocardial infarction

No. of patient	Age	Sex	Diagnosis	No. of diseased vessel	Revascularization	LVEF (%)*	LVEF (%)†
1	69	F	AMI	2	PTCA/STENT	56.9	59.0
2	74	F	AMI	1		54.6	61.0
3	58	M	AMI	1	PTCA	35.8	32.0
4	70	M	AMI	1	PTCA/STENT	44.5	42.0
5	56	M	AMI	1	CABG	50.3	53.0
6	75	M	AMI	1	PTCA/STENT	48.0	42.0
7	79	F	AMI	2	PTCA/STENT	43.6	36.0
8	64	M	AMI	1	PTCA/STENT	24.2	25.0
9	7	M	AMI	2	CABG	38.7	42.0
10	65	F	OMI	3	CABG	30.8	26.0
11	64	M	OMI	1		35.0	36.0
12	75	M	OMI	3		26.5	25.0
13	66	M	OMI	3		15.3	22.0
14	79	M	OMI	1		24.9	28.0
15	79	M	OMI	1		24.9	28.0
	70.0 ± 7.6					36.9 ± 12.5	37.1 ± 12.6

LVEF = left ventricular ejection fraction, AMI = acute myocardial infarction, OMI = old myocardial infarction, PTCA = percutaneous transluminal coronary angioplasty, CABG = coronary artery bypass graft surgery, Data are mean ± SD, *Ejection fraction by gated MIBI SPECT using QGS, †Ejection fraction by gated FDG PET using pFAST

cycle using an R-wave trigger.

Myocardial Gated SPECT

Myocardial gated ^{99m}Tc-MIBI SPECT was performed 1 hour after a rest injection of 750 MBq ^{99m}Tc-MIBI. Acquisitions were performed using a 90° dual-head camera (Millennium VG; GE, Yokogawa, Japan) equipped with low-energy high-resolution parallel-hole collimators. Acquisition parameters were as follows: 1.5 acquisition zoom; 30 projections over a 180° orbit; 30 s per projection; and 64 × 64 matrix (word mode). Images were gated at 16 frames per cycle using an R-wave trigger with an acceptance window set at 100%. Energy discrimination was provided by a 20% window centered on 140 keV. Gated ^{99m}Tc-MIBI SPECT images were reconstructed after low-pass prefiltering (Butterworth order, 10; cutoff frequency, 0.4 cycle per cm), and were reconstructed by the filtered backprojection method, using a Ramp reconstructed filter. No attenuation correction was performed. Perfusion images were obtained from gated ^{99m}Tc-MIBI SPECT by adding the reconstructed data in one composite image.

Patients and Data Analysis

Perfusion and metabolism images were evaluated by two experienced nuclear medicine physicians, who were unaware of the clinical data and reached a consensus. Forty-eight patients (38 men, mean age 68.1 ± 10.3 years old) admitted with known or suspected cardiac disease underwent gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT within a week to evaluate myocardial perfusion and function. In this study, patients with diabetes mellitus were excluded. The baseline diagnoses in the 48 patients were CAD (31 patients), mitral regurgitation (1 patients), paroxysmal arrhythmia (10 patients), and dilated cardiomyopathy (6 patients). In cases of CAD and dilated cardiomyopathy, patients underwent cardiac catheterization with those with dilated cardiomyopathy having normal coronary arteries. Left ventricular ejection fracton (LVEF) was calculated from the gated ^{18}F-FDG PET data, and then pFAST provided LV end-systolic and end-diastolic volumes (ESV and EDV) and LVEF. ESV, EDV, and LVEF were also calculated from the gated ^{99m}Tc-MIBI SPECT data. Intraobserver reproducibility of gated ^{18}F-FDG PET analysis with the pFAST program was assessed by two independent operators by calculating LVEF, EDV, and ESV in 48 patients. High reproducibilities were confirmed ($r = 0.907$, $p < 0.0001$ for LVEF; $r = 0.995$, $p < 0.0001$ for EDV; $r = 0.991$, $p < 0.0001$ for ESV). Figures 1A, 1B and 1C show that LVEF, EDV and ESV measured by gated ^{18}F-FDG PET were highly correlated with those obtained by gated ^{99m}Tc-MIBI SPECT ($r = 0.848$, 0.855 and 0.911, $p < 0.0001$, respectively). The mean values of LVEF, EDV and ESV obtained by gated ^{18}F-FDG PET were 41.5 ± 12.0%, 150.1 ± 55.8 m*l* and 92.3 ± 48.8 m*l*, respectively, whereas those obtained by ^{99m}Tc-MIBI SPECT were 41.5 ± 13.4%, 123.7 ± 46.2 m*l* and 77.5 ± 43.5 m*l*. The mean values of LVEF obtained by gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT did not differ significantly (Fig. 2, p = NS), but the mean values of EDV and ESV obtained by gated ^{18}F-FDG PET were significantly grater than those obtained by gated ^{99m}Tc-MIBI SPECT ($p < 0.0001$).

Fifteen of 48 patients who underwent myocardial

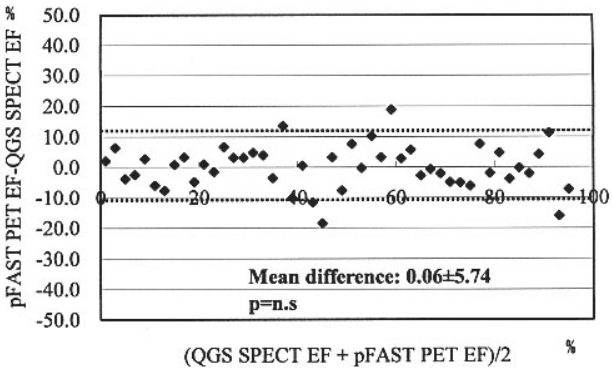


Fig. 2 Bland-Altman plot, showing good correlation of LVEF from ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET. Lines indicate mean and mean ± 2SD.

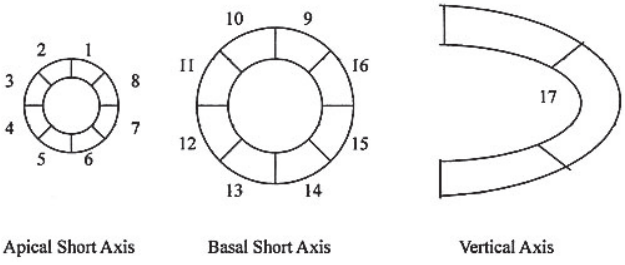


Fig. 3 The 17-segment model: two short axial views from apex to base and one vertical long axial view make up this model. Segments 1, 2, 3, 4, 9, 10, 11, 12 and 17 are in the left anterior descending distribution; segments 5, 6, 13 and 14 are in the right coronary artery distribution; and segments 7, 8, 15, and 16 are in the circumflex distribution.

viability study were diagnosed with myocardial infarction. Their baseline characteristics are shown in Table 1. Three patients had three-vessel disease, 3 two-vessel disease, and 9 one-vessel disease with significant (>75%) stenosis. Nine of the patients were diagnosed with acute myocardial infarction (AMI) and underwent successful revascularization. Six other patients were diagnosed with old myocardial infarction (OMI) and also underwent coronary angiography. The diagnosis of infarction was established on the basis of clinical, enzymatic and electrocardiographic criteria. In AMI patients, 6 (2 anterior wall infarction, 3 posterior wall infarction, 1 inferior wall infarction) underwent percutaneous transluminal coronary angioplasty (PTCA) and 2 (1 anterior wall infarction, 1 inferior wall infarction) underwent coronary artery bypass graft surgery (CABG). In the remaining patient (anterior wall infarction), coronary artery flow was restored with thrombolysis. Gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT were performed three weeks after hospitalization. Another 6 patients had a history of OMI and were hospitalized with congestive heart failure (CHF). The LV myocardium was divided into 17 segments (Fig. 3). Regional defect scores of ^{18}F-FDG PET and

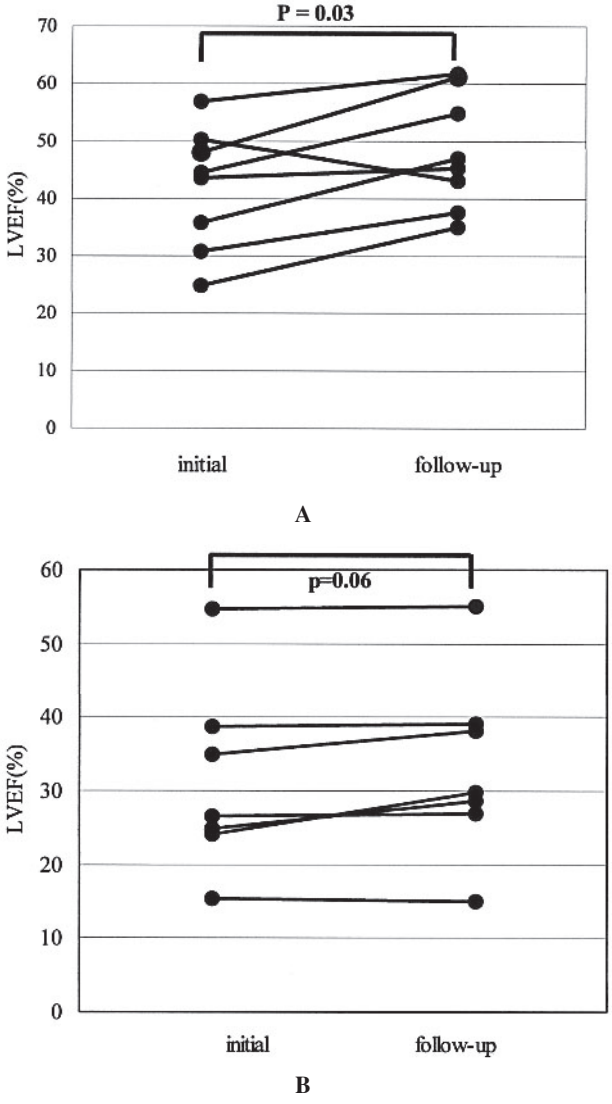
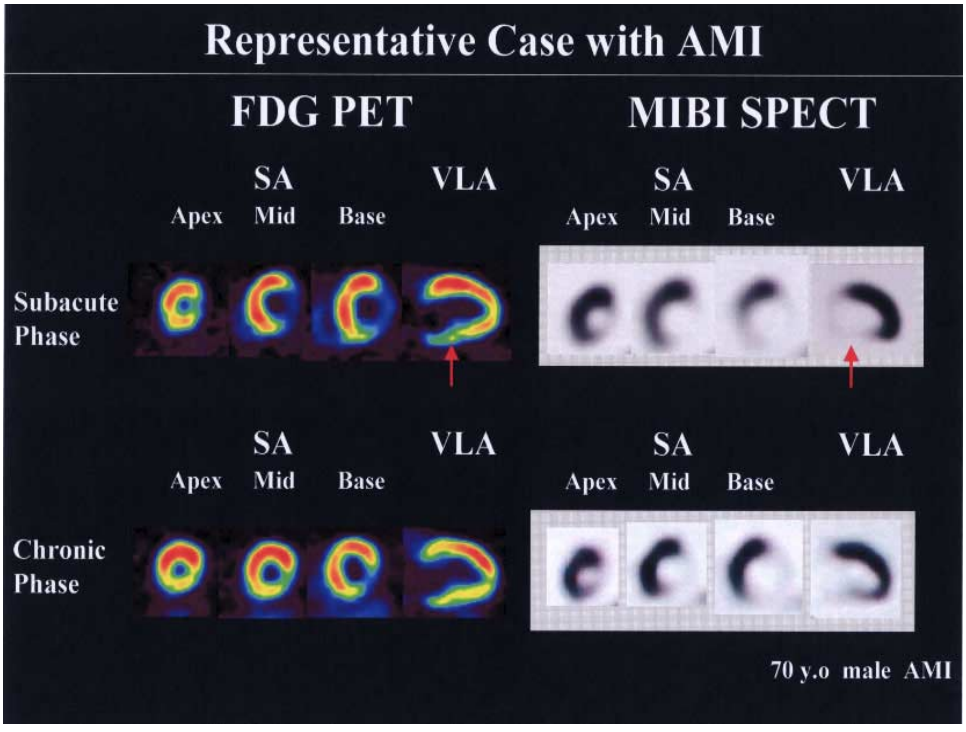
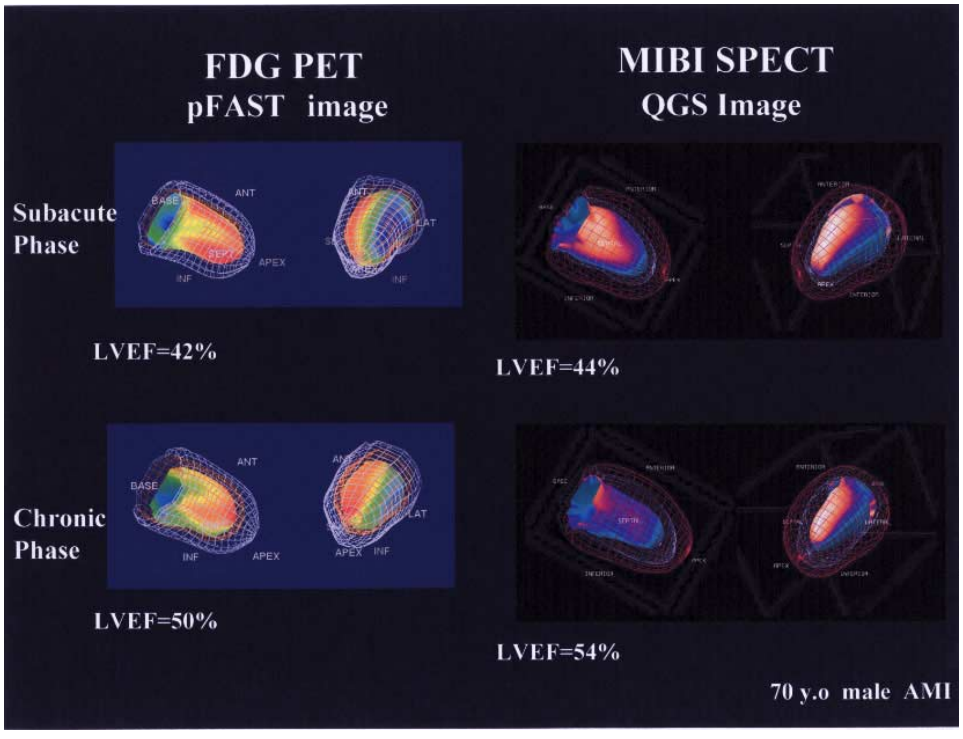


Fig. 4 A: LVEF from ^{99m}Tc-MIBI SPECT in MM-group. An increase in global ejection fraction is demonstrated in 8 patients in the MM-group. MM-group = patients with at least two mismatched segments. B: LVEF from ^{99m}Tc-MIBI SPECT in M-group. No increase in global ejection fraction is demonstrated in 7 patients in M-group. M-group = patients with < 1 mismatched segments.

^{99m}Tc-MIBI SPECT were visually assessed using a 4-point scale for each segment on nongated images summed from all cardiac cycle images (0 = normal tracer uptake, 1 = mildly reduced, 2 = moderately reduced and 3 = absence of tracer uptake). Regarding the territory of the coronary artery, the anteroseptal-to-apical region was considered to correspond to the left anterior descending coronary artery (LAD) territory, the lateral region to the left circumflex coronary artery (LCX) territory, and the inferoposterior region to the right coronary artery (RCA) territory. In normal myocardial images, uptake of ^{99m}Tc-MIBI SPECT or ^{18}F-FDG PET was relatively uniform, but in images with an abnormal distribution of



A



B

Fig. 5 A: Representative ^{18}F-FDG PET and ^{99m}Tc-MIBI SPECT in AMI. ^{18}F-FDG PET (*left*) and ^{99m}Tc-MIBI SPECT (*right*) images of a patient with recent MI show perfusion-metabolism mismatch in the inferoposterior wall (*arrows*) after revascularization. SA = short axis, VLA = vertical long axis. B: Images of gated ^{18}F-FDG PET in 3D mode of pFAST. The ratio of volumes in the end-systolic phase and -diastolic phase provides LVEF. ANT = anterior, LAT = lateral, INF = inferior, LVEF = left ventricular ejection fraction, EDV = end-diastolic volume, ESV = end-systolic volume.

radioactivity, two different patterns of ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET uptake were observed. A segment with a greater defect score on ^{99m}Tc-MIBI SPECT than on ^{18}F-FDG PET was defined as a perfusion-metabolism mismatch, indicating jeopardized but viable myocardium. Regions with a perfusion defect and matched decrease of ^{18}F-FDG PET uptake were defined as a match, indicating myocardial necrosis. The patients were divided into two groups: those with at least two mismatched segments (mismatch group: MM-group) and those with none or one (match group: M-group). Four months later, follow-up ^{18}F-FDG PET and ^{99m}Tc-MIBI QGS study were performed to assess the functional outcome. An improvement in ejection fraction of > 5% with ^{99m}Tc-MIBI QGS was defined as significant. The Ethics Committee of Yokohama City University School of Medicine approved the study protocol, and patients gave informed consent.

Statistical Analysis

Values are expressed as mean ± standard deviation. Comparison between gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT EF, EDV, and ESV was performed with Student's paired t-test. Correlations between gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT EF, EDV, and ESV were evaluated using simple linear regression. Fisher's exact test was used to test the association between global LV ejection fraction recovery and ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET uptake. Probability values less than 0.05 were considered significant.

RESULTS

Predictive Value of ^{18}F-FDG PET and ^{99m}Tc-MIBI SPECT

We were able to assess the myocardial viability of 15 of 48 patients with myocardial viability. Of the 255 segments, 145 (57%) were determined to have abnormal myocardial perfusion in ^{99m}Tc-MIBI SPECT, and 133 (52%) were determined to have abnormal glucose metabolism in ^{18}F-FDG PET. Fifty-three segments (21%) showed mismatch. The regional distribution of the mismatched segments was as follows: right coronary artery distribution (n = 16) 30%, circumflex distribution (n = 15) 28%, left anterior descending distribution (n = 22) 42%. We defined viable segments as those with >50% of the activity of the reference in ^{18}F-FDG PET, and all of the mismatch distribution met this criterion. A significant association ($p < 0.05$) was found between the relative uptake of ^{18}F-FDG PET and ^{99m}Tc-MIBI SPECT and the functional outcome 4 months later. Global LV function improved in 6 of the 8 patients showing mismatch (positive predictive value = 75%), but in only 1 of the 7 patients with matched defects (negative predictive value = 86%), resulting in a sensitivity of 86% and specificity of 75%. The overall accuracy of the combination of ^{18}F-FDG PET and ^{99m}Tc-MIBI SPECT uptake to predict global functional outcome was 80%. There was a relationship between the severity of mismatching and the degree of functional improvement after revascularization. In the improvement group (improvement in ejection fraction = 5%), the mean number of mismatched segments was 5. On the other hand, the mean number of mismatched segments was 2.3 in the no-improvement group (improvement in ejection fraction < 5%). Six patients showed improved LV function in the MM-group. Four of six patients were diagnosed with AMI and underwent successful revascularization. Two other patients were diagnosed with OMI, one patient underwent CABG and the other biventricular pacing. Two patients showed no improvement in LV function in the MM-group; one patient was diagnosed with AMI and restenosis of the stent. The other patient showed a 2% improvement of LV function. Six patients did not show improvement in LV function in the M-group. Four patients were diagnosed with OMI, and 2 were diagnosed with AMI and demonstrated successful revascularization after more than 12 hours. One patient with improved LV function in the M-group was diagnosed with a large anterior MI, and underwent biventricular pacing. Figures 4A and 4B show that global LVEF measured by gated ^{99m}Tc-MIBI SPECT significantly improved in the MM-group ($p = 0.03$), but did not improve in the M-group ($p = 0.06$).

Representative ^{18}F-FDG PET and ^{99m}Tc-MIBI SPECT images of a patient with a mismatch pattern are illustrated in Figures 5A and 5B. This patient (a 70-yr-old man) was diagnosed with AMI. He had one-vessel disease with an occluded LCX, and underwent successful revascularization within 2 hours. ^{18}F-FDG uptake (Fig. 5A, left) indicated preserved myocardial viability in areas of reduced resting perfusion (inferior and posterior) as assessed by ^{99m}Tc-MIBI SPECT (Fig. 5A, right). In the bull's eye map, ^{99m}Tc-MIBI SPECT uptake was severely reduced (47% of peak activity) and ^{18}F-FDG PET uptake was preserved (75% of peak activity). Four months after revascularization, LVEF had improved from 44% to 54% in gated ^{99m}Tc-MIBI SPECT and from 42% to 50% in gated ^{18}F-FDG PET.

DISCUSSION

Our findings demonstrated that gated ^{18}F-FDG PET can simultaneously evaluate metabolic viability and left ventricular function. This imaging approach allows accurate evaluation of myocardial viability. Furthermore, the high correlations of measurements of LVEF, EDV and ESV between gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT hold promise for the assessment of left ventricular function using gated ^{18}F-FDG PET. The assessment of myocardial viability is a clinically important issue for the management of patients with post-ischemic left ventricular dysfunction and particularly for those with severe impairment of left ventricular function.[1–4] Several studies have shown that ^{99m}Tc-MIBI myocardial perfusion SPECT

and ^{18}F-FDG myocardial metabolic PET are good methods to identify ^{13}N-ammonia perfusion PET and ^{18}F-FDG metabolic PET in the evaluation of myocardial viability and the indication for revascularization in patients with chronic coronary artery disease.[5–9] Zhang et al.[27] showed the role of a hybrid technique of ^{99m}Tc-MIBI SPECT and ^{18}F-FDG PET in evaluation of the prognosis, treatment strategy, and improvement of LV function of patients with MI and LV dysfunction. They reported that LVEF measured by echocardiography significantly improved after revascularization only in patients with = 2 mismatched segments. Furthermore, patients who underwent revascularization had a higher event-free survival rate compared with those who were treated medically. They concluded that revascularization can improve the LV function and clinical outcome of patients with = 2 mismatched segments of viable myocardium. In our study, global LV function improved in 6 of the 8 patients showing mismatch, but in only 1 of the 7 patients with matched defects, resulting in an accuracy of 80%. These findings suggest that this approach to assessment of myocardial viability not only predicts recovery of global LV dysfunction after myocardial revascularization, but also identifies the subgroup of patients with poor left ventricular function and heart failure who are most likely to show relief of symptoms of heart failure as a result of revascularization.

Germano et al. reported excellent reproducibility of LVEF and LV volume measurements obtained using their software QGS.[14–16,28] They reported that QGS data correlated highly with those obtained by conventional methods. On the other hand, underestimation of left ventricular volume and overestimation of LVEF with QGS have been described.[24,25] When there is a large perfusion defect or ventricular remodeling, completely automated edge detection with an asymmetrical Gaussian fitting of radial count profiles is unlikely to provide a precise LV trace. In spite of such problems, Shimotsu et al.[29] reported a high correlation between the values obtained from gated ^{99m}Tc-MIBI SPECT and LVG even in patients with moderate to severe myocardial perfusion defects (LVEDV: r = 0.90, LVESV: r = 0.92, LVEF: r = 0.77). Today, QGS is considered to be a useful tool for quantification. The algorithm of pFAST estimated LV volumes using the midpoint of tracer accumulation in the myocardial tissue and mathematic calculation.[21] Nakajima et al.[26] reported the accuracy of LVEF and EDV measured by gated ^{99m}Tc-MIBI SPECT and four different software programs in comparison with the values measured using GBP in 30 patients. These software programs showed a high correlation between EF or EDV and the results of gated blood-pool (GBP) study, and the pFAST results correlated best with the GBP study results. As reported, pFAST provides a value of LVEF that corresponds to that obtained using GBP PET or LVG in subjects without a perfusion defect, although it tends to overestimate LV volume. As for PET study, Okazawa et al.[30] reported the accuracy of LVEF, EDV and ESV measured by $^{13}NH_3$ gated PET using pFAST in comparison with the values measured using GBP imaging with C^{15}O PET and LVG. LVEF obtained from LVG and GBP PET showed an excellent linear correlation regardless of the presence of a defect in the perfusion image. However, gated perfusion PET with pFAST underestimated LVEF, especially in patients with a large perfusion defect. The LV volumes (ESV and EDV) obtained from pFAST were overestimated compared with those obtained from GBP PET both in patients with and without a defect. In a study using a simulation phantom, we previously reported the accuracy of LVEF, EDV and ESV measured by gated ^{18}F-FDG PET using pFAST in comparison with the values obtained by gated ^{99m}Tc-MIBI SPECT using QGS.[31] The values of LVEF, EDV and ESV measured by gated ^{18}F-FDG PET were 27% (phantom 25.7%), 141 m*l* (143 m*l*) and 104 m*l* (107 m*l*), respectively, whereas those measured by ^{99m}Tc-MIBI SPECT were 19%, 106 m*l* and 86 m*l*. Gated ^{18}F-FDG PET data were very close to the phantom values. In this study, LVEF, EDV and ESV measured by gated ^{18}F-FDG PET were highly correlated with the values obtained by gated ^{99m}Tc-MIBI SPECT (r = 0.848, 0.855 and 0.911, $p < 0.0001$, respectively). Furthermore, EDV and ESV values measured by ^{18}F-FDG PET were significantly greater than ^{99m}Tc-MIBI SPECT values. This tendency was in agreement with the phantom data. In our study, we performed gated ^{18}F-FDG PET using pFAST, which was the only software applicable to our PET system and file format. In the postprandial state, the normal myocardium shifts from utilizing fatty acids to glucose as the primary substrate for ATP production; thus, both hibernating and normal myocardium would demonstrate ^{18}F-FDG uptake. Therefore, preserved or even enhanced ^{18}F-FDG uptake in dysfunctional myocardial regions represents the presence of myocardial viability. The spatial and temporal resolution with PET is greater than that of SPECT. Moreover, in the case of perfusion-metabolism mismatch, we can trace a wide area of myocardium compared with the perfusion image. Thus, gated ^{18}F-FDG PET may evaluate left ventricular function more precisely.

Study Limitations

This study did not include any patients with diabetes mellitus. Gated ^{18}F-FDG PET acquisition accompanied by obtaining a dynamic PET scan with a single dose of $^{13}NH_3$ can simultaneously evaluate myocardial blood flow and cardiac function.[30] This method may be useful for patients with diabetes mellitus. Most of the patients in the myocardial viability study had single-vessel disease, and therefore were likely to have non-ischemic cardiomyopathy. Therefore, the usefulness of viability study in this population is limited. In the viability study, we performed the nuclear studies relatively soon after acute myocardial infarction. It is likely that despite the fact that blood flow

may be restored, particularly, in the acute setting, perfusion would still be abnormal in the ^{99m}Tc-MIBI study as well as in the ^{18}F-FDG PET imaging studies. Even in this setting, our data suggested that combined use of ^{99m}Tc-MIBI and ^{18}F-FDG PET could evaluate myocardial viability. Nonetheless, it is possible that the results of recent MI data are not equivalent to the results of OMI data. Further studies are needed to examine the difference of these settings. The validity of the gated ^{18}F-FDG PET, pFAST data was evaluated by comparing the results with those obtained by means of ^{99m}Tc-MIBI QGS. QGS is considered to be a convenient tool for quantification, and high reproducibility has been achieved in selected subjects. However, underestimation of LV volume with QGS has been described previously.[24,25] Additional studies which will be analyzed using the same software, and gated blood pool PET studies will provide more accurate information about cardiac function and LV volume, especially in patients with a large defect or small heart.

CONCLUSION

Our findings demonstrated that gated ^{18}F-FDG PET can simultaneously evaluate metabolic viability and left ventricular function. This imaging approach allows accurate evaluation of myocardial viability. Furthermore, the high correlations of measurements between gated ^{18}F-FDG PET and gated ^{99m}Tc-MIBI SPECT hold promise for the assessment of left ventricular function using gated ^{18}F-FDG PET.

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