Increased Uptake of Iodine-123-BMIPP in Chronic Ischemic Heart Disease: Comparison with Fluorine-18-FDG SPECT

Gerrit W. Sloof, Frans C. Visser, Jeroen J. Bax, Arthur van Lingen, Jos Eersels, Furn F. Knapp, Jr. and Gerrit J.J. Teule
Departments of Nuclear Medicine and Cardiology and Radio Nuclide Centre, Free University Hospital, Amsterdam, The Netherlands; and Nuclear Medicine Group, Oak Ridge National Laboratory, Oak Ridge, Tennessee

To evaluate the potential role of 15-p-[^{123}I]iodophenyl-3-(R,S)-methylpentadecanoic acid (BMIPP) for the assessment of myocardial viability, the patterns of BMIPP versus ^{18}F-fluorodeoxyglucose (FDG) uptake were evaluated in patients with chronic ischemic heart disease. **Methods:** Twenty-one patients with stable chronic coronary artery disease underwent resting Tl SPECT to delineate myocardial perfusion followed by FDG SPECT to detect residual viability in regions showing perfusion defects. Resting BMIPP SPECT was obtained on a separate day. SPECT images were displayed as polar maps (13 segments) and analyzed semiquantitatively. A total of 273 segments were analyzed. **Results:** In 87 (32%) of the segments, a perfusion defect was observed. In perfusion defects, the distributions of BMIPP/Tl (mis)matches were significantly different ($p < 0.0001$) between the FDG viable ($n = 42$) and nonviable ($n = 45$) segments. A BMIPP/Tl mismatch (BMIPP uptake higher than perfusion) was found in 74% of FDG viable segments, whereas a BMIPP/Tl match (BMIPP uptake equal or lower than perfusion) was found in 69% of FDG nonviable segments. Agreement between matching or mismatching of segments was assessed to be 71%. Agreement was 81% when the data were analyzed on a patient basis. The observed frequency of BMIPP/Tl mismatches was significantly higher ($p < 0.05$) in segments with an old myocardial infarction (20 of 36; 55%) than it was in subacute infarcted myocardium (5 of 21; 24%). **Conclusion:** In chronically hypoperfused myocardium, an increased BMIPP uptake relative to perfusion was detected, which is different from the decreased BMIPP uptake often reported in (sub)acute myocardial ischemia. Therefore, the interval from infarction may be an important factor in the interpretation of BMIPP scintigraphic data. Increased BMIPP uptake was associated with FDG/Tl mismatches and may, therefore, confirm myocardial viability. Some segments with a FDG/Tl mismatch, however, revealed a BMIPP/Tl match. These segments may contain viable but more severely damaged tissue. Further studies on functional recovery are warranted to assess the significance of a BMIPP/perfusion (mis)match for tissue viability.

Key Words: iodine-123-BMIPP; fluorine-18-FDG; chronic ischemic myocardium

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Assessment of hypoperfused, but viable, myocardium is important for the therapeutic management of patients with chronic ischemic heart disease and depressed left ventricular function. PET using ^{18}F-fluorodeoxyglucose (FDG) is considered the gold standard for noninvasive assessment of tissue viability. However, FDG PET is an expensive and, therefore, not widely used technique. Recently, it has been demonstrated that detection of FDG by SPECT with ultra-high-energy collimators provides similar clinical information on tissue viability (*1–3*).

Fatty acids are the main energy source for the normoxic myocardium, and there has been a long history of investigations on cardiac metabolism using fatty acids (*4,5*). Iodine-123-labeled 15-p-iodophenyl-3-(R,S)-methylpentadecanoic acid (BMIPP) is currently considered the most suitable tracer for monitoring regional cardiac fatty acid uptake in the human (*6,7*), and it has been recently suggested that BMIPP used in conjunction with flow tracers may also provide information on tissue viability (*8–11*). However, only limited studies comparing fatty acid and glucose metabolism have been reported (*12*).

Most animal and patient studies with BMIPP were performed shortly after an acute myocardial infarction or unstable angina. In the acute stage of myocardial ischemia, severely depressed fatty acid uptake and metabolism can be anticipated (*2,13*), and thus, decreased BMIPP uptake is often detected. In contrast, little is known about the relative uptake patterns of glucose versus fatty acids in the more chronic stage of myocardial ischemia.

The aim of this study was, therefore, to evaluate the uptake patterns of BMIPP and FDG in patients with subacute or chronically hypoperfused myocardium.

MATERIALS AND METHODS

Study Population

From November 1995 to March 1996, 25 patients were referred to the Department of Nuclear Medicine for FDG/^{201}Tl SPECT to assess myocardial tissue viability. Twenty-one patients also underwent BMIPP SPECT 6–19 days afterward and were included in this study protocol. The remaining four patients either refused or were not eligible for logistic reasons because of immediate surgery or hospitalization elsewhere.

All patients were stable during the study, and none presented with unstable angina or myocardial infarction between the investigations. Medication was continued on the study day and did not change between investigations. Nineteen patients had a previous myocardial infarction at least 3 wk prior to their studies (3 wk–19 yr; median, 9 mo). Patient characteristics are listed in Table 1.

Imaging Protocols

For all acquisitions, a large field-of-view dual-head camera (ADAC Laboratories, Milpitas, CA) was used, and a total of 64 views were obtained over 360° taking 30 sec per view. Six-millimeter-thick transaxial slices were reconstructed from the raw scintigraphic data by filtered backprojection using a Hanning-0.9 filter without attenuation correction. Further reconstruction yielded short- and long-axis slices perpendicular to the heart axis.

Myocardial Perfusion. To delineate regional myocardial perfusion, a ^{201}Tl SPECT was performed under resting conditions. The

Received Dec. 23, 1996; revision accepted Apr. 30, 1997.
For correspondence or reprints contact: Gerrit W. Sloof, MD, Department of Nuclear Medicine, Free University Hospital, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands.

TABLE 1
Study Population

Characteristic	
Total no.	21
Age (yr)	60 ± 15
No. of men/no. of women	17/4
Myocardial infarction	
No. of patients (n)	19
No. of infarctions (n)	24
Thrombolysis (n)	3
Location and interval	
Anterior	
Old (>6 wk) (n)	7
Subacute (3–6 wk) (n)	5
Inferior	
Old (>6 wk) (n)	9
Subacute (3–6 wk) (n)	3
Coronary anatomy (n = 17)	
One vessel disease (n)	5
Two-vessel disease (n)	3
Three-vessel disease (n)	9
Ejection fraction (%)	35 ± 12
Diabetes mellitus	
Insulin-dependent (n)	1
Non-insulin-dependent (n)	2
Medication	
B-blockade (n)	11
ACE inhibitors (n)	14
Nitrates (n)	11
Ca antagonists (n)	2
Substrate levels (prior to BMIPP study)	
Glucose (mmol/liter)	5.6 ± 1.2
Lactate (mmol/liter)	1.2 ± 0.3
Free fatty acids (mmol/liter)	0.38 ± 0.3

camera was equipped with low-energy, high-resolution collimators, and imaging was started 10 min after intravenous injection of 111 MBq of ^{201}Tl-chloride (*3,14*).

FDG Imaging. After the resting Tl SPECT, FDG imaging was performed on the same day after Acipimox administration (*15*); patients received 250 mg of Acipimox (Byk, The Netherlands) orally and, 45 min later, had a carbohydrate- and protein-enriched meal containing 70 g of carbohydrates, 41 g of protein and 21 g of fat, for a total of 639 cal. Fluorodeoxyglucose (185 MBq) was injected 120 min after Acipimox administration. Forty-five minutes later, 165 min after Acipimox administration, the acquisition was initiated using an ultra-high-energy (511-keV) collimator (*16*).

BMIPP Preparation and Imaging. For the radioiodination of BMIPP, we applied the Cu^{+}-assisted nucleophilic exchange method (*17*). Purification was performed by a Sep-Pak RP-18 Light cartridge. To the evacuated radioiodinated BMIPP (in 0.5 ml of pure EtOH), a 5% human serum albumin solution was added with vigorous vortexing. The final solution was sterilized by means of a 0.22-μm Millipore filter. Quality control of the Sep-Pak eluate was performed by means of high-performance liquid chromatography. The radiochemical purity in each preparation was higher than 99%, and the specific activity was 190–210 MBq/μmole.

Six to 19 days after the FDG/resting Tl SPECT, the BMIPP SPECT was performed using a low-energy, high-resolution collimator. Acquisition was initiated 30–45 min after intravenous injection of 111 MBq of BMIPP, with patients at rest in a fasting state for at least 3 hr. Venous blood samples were collected before BMIPP administration for measurement of glucose, lactate and unlabeled free fatty acid levels (Table 1).

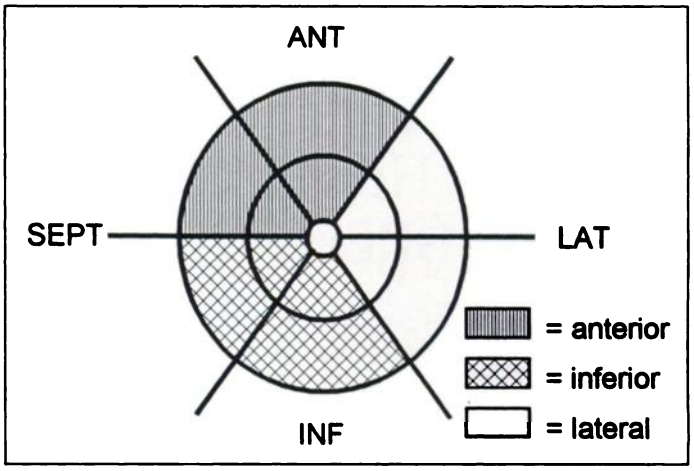

FIGURE 1. Polar maps were divided into 13 segments. The anterior, inferior and lateral regions are indicated.

Image Analysis

Segmental Analysis. Semiquantitative analysis of the SPECT data was performed as described previously (*3*). Briefly, circumferential count profiles (60 radii, highest pixel activity/radius) were generated from the Tl, FDG and BMIPP short-axis slices, discarding the slices containing the outflow tract. The available slices were presented in a polar map. The polar maps were divided into 13 segments (Fig. 1). Each polar map was normalized for peak activity (100%). A perfusion defect was present when Tl activity was below 2 s.d. values of mean normal values from our database (*3,18,19*).

Criteria for Viability. Myocardial viability was defined by a ≥7% increased FDG uptake in Tl perfusion defects as compared to the Tl activity (FDG/Tl mismatch). The cutoff value of 7% increased FDG uptake in Tl perfusion defects has been established using receiver operating characteristics analysis on the level of increased FDG uptake in patients undergoing revascularization (*19*). The 7% cutoff value appeared to discriminate best between segments that improved in function after revascularization versus the segments that did not improve. Similarly, nonviable, necrotic myocardium was considered when FDG uptake did not exceed Tl uptake by 7% (FDG/Tl match).

BMIPP. When BMIPP uptake exceeded Tl uptake by 8.5% in the septal region and by 7% in the remaining left ventricular region, the myocardial segment was classified as a BMIPP/Tl mismatch; otherwise, it was classified as a BMIPP/Tl match. This threshold has been documented by Tamaki et al. (*20*) in normal subjects, in which BMIPP appeared to be homogeneously distributed, but a correction of relative uptake values has to be made for different photon energy.

Patient-Based Analysis. A patient-based analysis was also performed. Patients, instead of segments, were classified according to the combination of a particular FDG and BMIPP/perfusion (mis) match that was found in 50% or more of the hypoperfused area.

Statistics. Comparison of proportions was performed using chi-square analysis. A p-value of less than 0.05 was considered significant. To study the relationship between FDG or BMIPP uptake relative to perfusion, linear regression was applied in perfusion defects.

RESULTS

In 87 of the 273 (32%) segments, a perfusion defect was identified. Sixty-six percent (57 of 87) of the perfusion defects were located in previously infarcted myocardium. Thirty-eight percent (33 of 87) of the perfusion defects were localized in the anterior/anteroseptal wall, 29% were in the inferior/inferoseptal

TABLE 2
Segment-Based Analysis of 102 Perfusion Defects in 21 Patients with Ischemic Heart Disease

	FDG/Tl		
	Nonviable	Viable	Total
BMIPP = Tl (match)*	31	11	42
BMIPP > Tl (mismatch)*	14	31	45
Total	45	42	87

*Significantly different ($p < 0.0001$) distribution of BMIPP/Tl (mis)matches over FDG viable and nonviable segments. Agreement = 71%.

wall, 21% were in the lateral wall and the remaining 12% were in the apical region.

In perfusion defects, 45 FDG nonviable and 42 FDG viable segments were found. There were 45 BMIPP/Tl mismatches (BMIPP > perfusion) and 42 BMIPP/Tl matches, as presented in Table 2. The distributions of BMIPP/Tl (mis)matches were significantly different ($p < 0.0001$) between the FDG viable and nonviable segments. A BMIPP/Tl mismatch was found in 74% (31 of 42) of FDG viable segments, whereas 69% (31 of 45) BMIPP/Tl-matched defects were found in FDG nonviable segments.

Agreement between matching/mismatching of segments was 71%. In perfusion defects, the difference between FDG and Tl uptake (FDG − Tl = FDG_{DIF}) positively correlated with the difference between BMIPP and Tl uptake (BMIPP − Tl = $BMIPP_{DIF}$): FDG_{DIF} (%) = 0.43 * $BMIPP_{DIF}$ (%) + 3.3 ($r = 0.31$, s.e.e. = 10.2, $n = 87$, $p < 0.001$) (Fig. 2).

Frequency of FDG/Perfusion and BMIPP/Perfusion Mismatches in the Perfusion Defects over the Myocardial Regions

The frequency of BMIPP/Tl mismatches was higher in the anterior wall than it was in the lateral wall or apex ($p < 0.05$) and inferior wall (not significant). The relative frequencies of FDG/Tl mismatches were not significantly higher in a specific region of the heart (Table 3).

The frequency of FDG/Tl mismatches was relatively higher

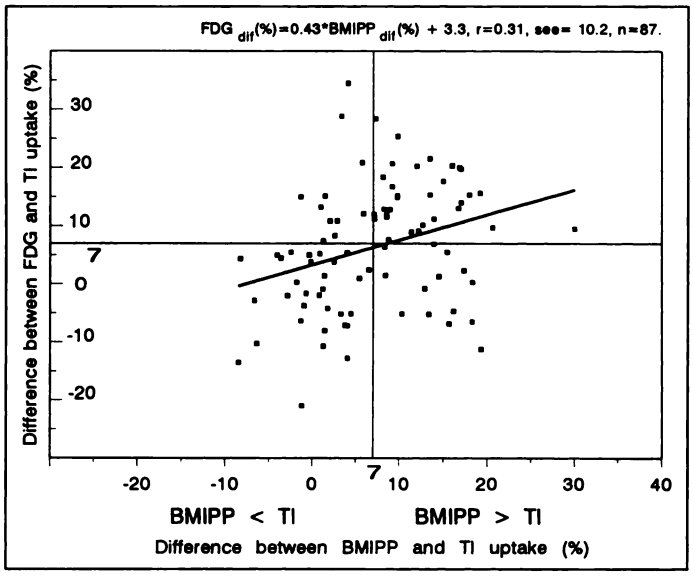

FIGURE 2. Scatter plot showing the relationship between FDG and BMIPP uptake relative to perfusion (metabolism − perfusion difference = FDG_{dif} and $BMIPP_{dif}$, respectively) in the 87 perfusion defects. When the difference was ≥7%, it was defined as a FDG/Tl or BMIPP/Tl mismatch. Therefore, the x- and y-axes were placed at the 7% threshold.

TABLE 3
Frequency of FDG and BMIPP/Perfusion Mismatches in the Perfusion Defects over the Myocardial Regions

	Total	FDG		BMIPP	
	no.	Mismatch	Match	Mismatch	Match
Localization					
Anterior	33	18	15	24*	9
Inferior	25	12	13	12	13
Lateral	18	10	8	6*	12
Apex	11	2	9	3*	8
Infarction					
None	30	21†	9	20‡	10
Subacute	21	7†	14	5‡	16
Old	36	14†	22	20‡	16
Total	87	42	45	45	42

*Significantly more ($p < 0.05$) BMIPP mismatches in anterior vesus lateral or apical regions.

†Significantly more ($p < 0.05$) FDG mismatches in no infarctions versus subacute or old infarcted myocardial regions.

‡Significantly less ($p < 0.05$) BMIPP mismatches in subacute versus none or old infarcted myocardial regions.

($p < 0.05$) in perfusion defects of regions with no infarctions, compared to infarcted, subacute or old regions (Table 3). The observed frequency of BMIPP/Tl mismatches was less ($p < 0.05$) in subacute infarcted myocardium, compared to regions with an old myocardial infarction or without a myocardial infarction (Table 3). Moreover, there were two segments with a BMIPP uptake lower (at least 7%) than perfusion; both were found in subacute infarcted myocardium.

Furthermore, there was no significant difference in the distributions of frequencies of FDG versus BMIPP mismatches or matches per region (Table 3).

Patient-Based Analysis

There were 4.4 ± 1.6 perfusion defects per patient with a maximum of eight perfusion defects in one patient. The distributions of patients with BMIPP/Tl (mis)matches were significantly different ($p < 0.05$) between the FDG viable and nonviable patients: a predominant BMIPP/Tl mismatch was found in 83% (10 of 12) of the FDG viable patients, and a predominant BMIPP/Tl match was found in 78% (7 of 9) of FDG nonviable patients (Table 4).

Ten patients showed both a FDG/T1 and BMIPP/Tl mismatch. Typical examples of both a FDG/Tl and BMIPP/Tl mismatch are shown in Figures 3 and 4. Seven patients showed a totally matched pattern (Fig. 5). Figures 6 and 7 show examples of scintigrams in which FDG and BMIPP/Tl (mis) match patterns were discordant.

TABLE 4
Patient-Based Analysis of Relative FDG and BMIPP Uptake in Ischemic Myocardium

	FDG/Tl		
	Nonviable	Viable	Total
BMIPP = Tl (match)*	7	2	9
BMIPP > Tl (mismatch)*	2	10	12
Total	9	12	21

*Significantly different ($p < 0.05$) distribution of BMIPP/Tl (mismatched patients over FDG viable and nonviable patients. Agreement = 81%.

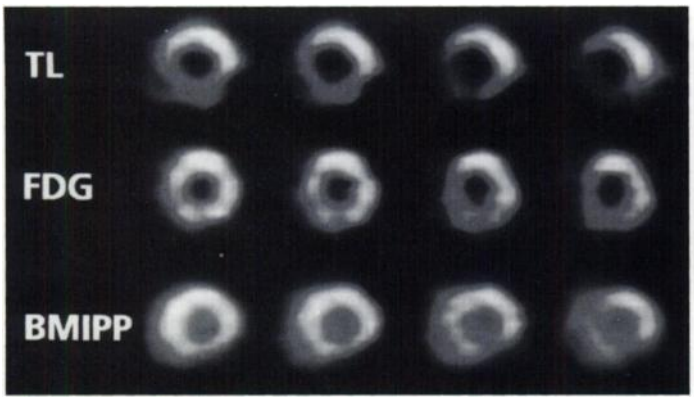

FIGURE 3. Myocardial short-axis slices of a patient (62-yr-old man) with three-vessel disease without a previous infarction, showing both a FDG/Tl and a BMIPP/Tl mismatch in the inferior wall (right coronary artery = 99% stenosis).

DISCUSSION

Identification of myocardial regions with high or low probabilities of functional improvement after restoration of coronary flow is important for the decision-making process of a revascularization procedure, either coronary artery bypass grafting or percutaneous transluminal coronary angioplasty. It appeared that dysfunctional, hypoperfused segments with preserved FDG uptake (FDG/perfusion mismatch) showed functional improvement. In contrast, segments with a FDG/perfusion match did not improve in function after revascularization (*21–24*). The match pattern represents scarred tissue, whereas the mismatch pattern is thought to represent jeopardized but viable myocardium.

Although the PET data clearly demonstrate that FDG PET can adequately predict functional recovery after revascularization, widespread clinical application of this technique is still hampered by the limited availability and high costs. Recently, it has been demonstrated that detection of FDG by SPECT with ultra-high-energy collimators provides similar clinical information on tissue viability (*1–3*). Therefore, FDG SPECT allows the use of FDG on a routine basis in centers without a PET camera.

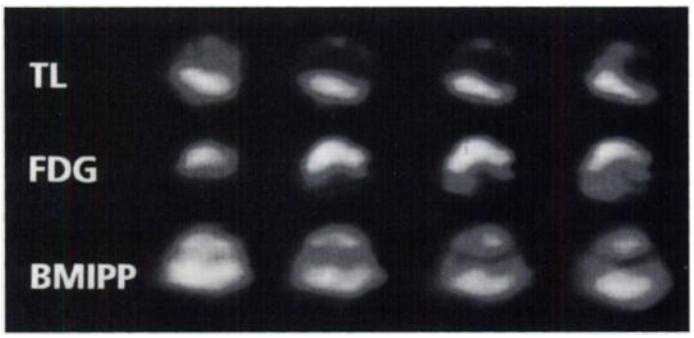

FIGURE 4. Patient (37-yr-old woman) with an old anterior myocardial infarction, 4 yr earlier. The vertical long-axis shows a severe perfusion defect in the anterior wall, with both a FDG/perfusion and a BMIPP/perfusion mismatch.

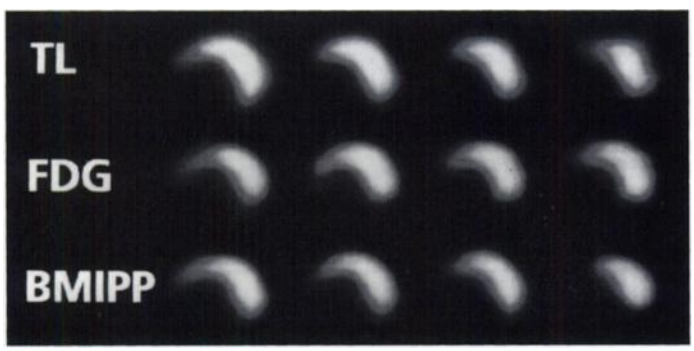

FIGURE 5. Patient (73-yr-old man) with an 11-yr-old inferoseptal myocardial infarction. All tracers show a severe, matched defect in the infarcted area.

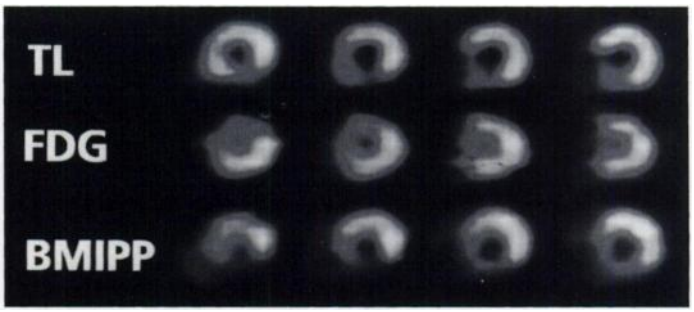

FIGURE 6. Patient (73 yr-old man) with a 14-yr-old inferior myocardial infarction. The short-axis slices show a FDG/Tl mismatch but a BMIPP/Tl match in the inferior wall.

More recently, it has been suggested that BMIPP/perfusion imaging may also provide information on tissue viability (*6–12*). Most of these patient studies with BMIPP have been performed in the acute stage of myocardial ischemia in which decreased BMIPP uptake relative to perfusion is often found. However, recovery of fatty acid uptake and metabolism after transient ischemia has been demonstrated in experimental animal studies (*13,25,26*). Because BMIPP is now considered the most suitable tracer to monitor regional fatty acid uptake by SPECT, we evaluated the uptake patterns in chronic ischemic heart disease and made a comparison with FDG viable and nonviable myocardium.

This study revealed that FDG nonviable segments often (69%) showed a BMIPP/perfusion match. This combined matched pattern strongly suggests the presence of necrotic myocardial tissue.

The majority (74%) of FDG viable segments also showed a relatively increased BMIPP uptake to perfusion (BMIPP/Tl mismatch). Hypoperfused segments, in which both glucose and fatty acid uptake are enhanced, indicate the presence of metabolically active myocardial tissue. One may assume that the vital conditions for myocardial metabolism are preserved, such as integrity of membranes and subcellular organelles and that the levels of (co)enzymes, lactic acid, etc. are embalanced.

In FDG viable segments, a smaller (26%) group with a BMIPP/perfusion match was also found, which may reflect more severely damaged myocardium (see below).

To our surprise, some segments with a FDG/perfusion match showed a BMIPP/perfusion mismatch suggesting residual tissue metabolism by BMIPP scintigraphy. We have currently no valid, evidence-based explanation for this observation. Differences in photon energy were an unlikely explanation because the majority of these segments (8 of 14) were located in the anterior wall. Assessment of functional outcome after revascularization is mandatory for a better understanding of these observations.

Uptake of FDG relative to perfusion have been compared with structural changes in biopsies of patients with chronic ischemic heart disease (*27,28*). These studies showed that functional improvement after revascularization is strongly associated with the extent and severity of tissue fibrosis, with the relative amount of metabolically active and morphologically viable, albeit often structurally remodeled, cardiomyocytes. Segments with a FDG/perfusion mismatch showed less fibrosis than did matched segments. Furthermore, most but not all patients with a FDG/perfusion mismatch showed functional

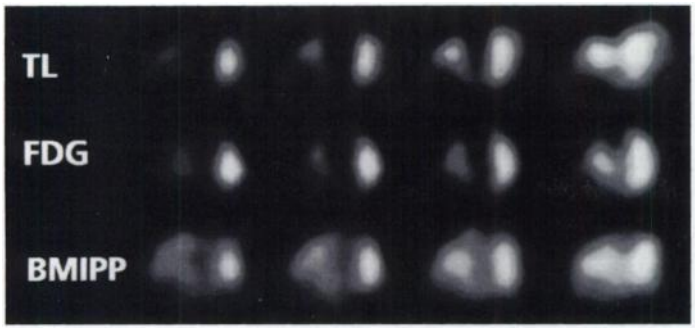

FIGURE 7. Female patient with a 6-yr-old anteroseptal infarction. The horizontal long-axis shows a FDG/Tl match but a BMIPP/Tl mismatch in the septal wall.

improvement after revascularization. Depré et al. (*28*) found a wide range of fibrosis in biopsies of patients showing functional myocardial improvement (2–48 vol%) or showing persistent dysfunction (33–95 vol%). These findings suggest that different degrees of myocardial damage exists and that FDG/perfusion imaging alone cannot always predict functional outcome.

Preservation of oxidative metabolism, as assessed by ^{11}C-acetate using PET, has been found to be necessary for functional recovery after revascularization (*29,30*). Carbon-11-acetate showed a higher positive and negative predictive value for functional recovery than did FDG PET, which suggests that functional recovery may depend more strongly on maintenance of oxidative metabolism. However, metabolism of ^{11}C-acetate cannot be assessed by conventional gamma cameras; alternatively, BMIPP imaging is simple and can be performed on a routine basis. Although BMIPP uptake primarily reflects cellular uptake of fatty acids instead of oxidative metabolism, fatty acid uptake is closely related to oxidative, mitochondrial metabolism in steady-state conditions, which, we may assume, prevails in stable chronic ischemic heart disease (*5*). Moreover, BMIPP is eventually, after alpha-oxidation, oxidized by mitochondrial beta-oxidation (*31,32*), and close relationships have been found between BMIPP uptake and ^{11}C-palmitate uptake (*33*), BMIPP uptake and ATP content (*11,34*) and between early washout of BMIPP and administration of etomoxir, which create a condition comparable with ischemia (*35*).

Maes et al. (*27*) showed a loss of sarcomeres in structurally changed cells in the ischemic area, with the space occupied not only by glycogen but also mitochondria, where fatty acids are activated on the outer membrane. These findings may support our findings of an increased BMIPP uptake relative to perfusion.

Most patient studies with BMIPP have reported decreased BMIPP uptake relative to perfusion, and this phenomenon has been referred to as discordant BMIPP segments (*6,8–10,12,36*). In this study, there were only two hypoperfused segments (2%) with such a discordancy, and they were found in subacutely infarcted myocardium. Instead of showing a reciprocal pattern, in perfusion defects, a positive correlation between relative FDG and BMIPP uptake was found. Moreover, there was a moderate agreement between matching and mismatching (71%). This suggests that BMIPP and FDG uptakes are not reciprocal in chronic ischemic myocardium, provided that these tracers are investigated under their own optimal substrate conditions, i.e., high free fatty acid levels (fasting) for the BMIPP study and low free fatty acid levels (Acipimox) for the FDG study. The explanation for this unusual finding for BMIPP may be that, in contrast to this study group, most earlier study populations consisted of (sub)acute infarctions or unstable angina. Tamaki et al. (*12*) compared BMIPP and FDG uptake in patients with previous acute myocardial infarction or unstable angina and found predominantly discordant BMIPP uptake (BMIPP uptake lower than perfusion) in segments with a glucose/perfusion mismatch. The time interval between the onset of acute ischemia and scintigraphy might be an important factor to explain the different findings because, in the acute phase of myocardial ischemia, fatty acid uptake and metabolism are severely depressed (*5*). This explanation is also supported by the findings of Schwaiger et al. (*13*), who showed the recovery of fatty acid uptake and metabolism in a chronic dog model after transient ischemia over a 4-wk period. A higher BMIPP-uptake relative to perfusion has been found in occlusion/reperfusion canine models (*25,26*).

A fatty acid/perfusion mismatch (fatty acid uptake greater than perfusion) has been observed in patients for other, less common fatty acid analogs (*37,38*). Henrich et al. (*37*) compared FDG and 15-ortho-iodophenyl-pentadecanoic acid (oIPPA) uptake in irreversible Tl defects of 32 patients after myocardial infarction that was >4 wk old and found normal FDG as well as oIPPA uptake in 21.8% of the perfusion defects and normal oIPPA but decreased FDG uptake in 10.3%. Marie et al. (*38*) found that 16-iodo-3-methylhexadecanoic acid showed a relatively higher uptake than did perfusion (59% of irreversible Tl defects) in patients with prior myocardial infarction (10 days to 6 mo). Recently, Jonas et al. (*39*) described increased uptake of 13-(p-[^{123}I]iodophenyl)−3-(p-phenylene)-tridecanoic acid, a fatty acid analog, relative to perfusion in histologically viable myocardium of an explanted human heart, whereas a matched fatty acid uptake/perfusion pattern was found in fibrotic, scarred tissue. Thus, these animal data and data with fatty acid analogs other than BMIPP in patients are in line with our unique findings for BMIPP in humans.

Agreement increased when the data were analyzed on a patient basis. An explanation for this finding might be the enhanced heterogeneity in both perfusion and metabolism that may occur in ischemic myocardium (*40,41*). When data are analyzed on a patient basis, the effect of heterogeneity on the classification will subside. Eventually, for the decision-making process of revascularization, coronary artery bypass grafting or percutaneous transluminal coronary angioplasty, the findings in the majority of segments (i.e., patient-based analysis), instead of individual segments, will be of major importance.

Study Limitations

Some limitations of our study should be acknowledged:

1. This study lacks data on functional recovery. So far, only a few patients in this study group have undergone revascularization, the gold standard for viability. Moreover, most of them were in the subgroup of patients with predominantly FDG/perfusion mismatching. None of the two patients with predominantly FDG/perfusion mismatches (Table 4) and BMIPP/perfusion matches have undergone a revascularization procedure. Further studies on functional recovery are warranted to assess the significance of a BMIPP/perfusion (mis)match for tissue viability. For this purpose, the study population would be enlarged. In advance, this study was undertaken to evaluate uptake patterns of BMIPP in chronic ischemic myocardium.
2. Because cross-over of peak energy of ^{201}Tl and ^{123}I has to be avoided, the perfusion study using Tl and the BMIPP study were conducted at least 5 days apart. In some cases, the time interval was >1 wk. This raises the possibility that intervening events could have influenced the outcome in individual cases. However, this possibility is unlikely

because all patients were in stable condition, without the occurrence of cardiac events during the study period.

CONCLUSION

In chronically hypoperfused myocardium, an increased BMIPP uptake relative to perfusion was detected, which is different from the decreased BMIPP uptake often reported in (sub)acute myocardial ischemia. Therefore, the interval from infarction may be an important factor in the interpretation of BMIPP scintigraphic data.

Increased BMIPP uptake was associated with FDG/Tl mismatches and may, therefore, confirm myocardial viability. Some segments with a FDG/Tl mismatch, however, revealed a BMIPP/Tl match. These segments may contain viable but more severely damaged tissue. Further studies on functional recovery are warranted to assess the significance of a BMIPP/perfusion (mis)match for tissue viability.

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