Abnormal BMIPP Uptake in Chronically Dysfunctional Myocardial Segments: Correlation with Contractile Response to Low-Dose Dobutamine

Anne-Sophie E. Hambÿe, Marc M. Vaerenberg, André A. Dobbeleir, Paul A. Van den Heuvel and Philippe R. Franken
Departments of Nuclear Medicine and Cardiology, Middelheim Hospital, Antwerp; and Department of Nuclear Medicine, Free University of Brussels, Brussels, Belgium

Discordance between ^{123}I-15-(p-iodophenyl)-3-(R,S)-methyl pentadecanoic acid (BMIPP) and sestamibi uptake has been described as a good predictor of functional recovery in patients with a recent myocardial infarction. The current investigation aimed at evaluating BMIPP as a viability tracer in patients with chronic ischemic left ventricular dysfunction. **Methods:** Thirty-one studies were obtained in 25 patients with severe left ventricular dysfunction postinfarction (median infarction age 3.6 mo; range 2 wk–15 yr). All patients underwent dobutamine stress echocardiography and a resting ^{99m}Tc-sestamibi/^{123}I-BMIPP SPECT study in a 3-day interval. The relative uptake of the two tracers was compared to the evolution of wall motion during dobutamine infusion in 8 matched myocardial segments. **Results:** Among the 130 segments with abnormal wall motion at rest, 70 improved under dobutamine. Using sestamibi, a normal uptake was 88% predictive of a positive response to dobutamine, and a decreased uptake of 63% predicted negative stress echocardiography response. In the segments with abnormal sestamibi uptake, adding BMIPP significantly increased the accuracy of scintigraphy to detect residual viability; 28 of 48 segments (58%) with a mismatched pattern demonstrating residual inotropic reserve under dobutamine infusion versus only 5 of 40 segments (13%) with a matched defect. Global agreement between the two approaches was 77%, and positive and negative predictive values for scintigraphy were 72% and 88%, respectively. **Conclusion:** In patients with chronic ischemic left ventricular dysfunction, the combined assessment of metabolism and perfusion with ^{123}I-BMIPP and ^{99m}Tc-sestamibi correlates well with the response of wall motion to dobutamine during stress echocardiography and is more sensitive than sestamibi alone for differentiating viable from scar segments.

Key Words: iodine-123-15-(p-iodophenyl)-3-(R,S)-methyl pentadecanoic acid; old myocardial infarction; technetium-99m-sestamibi; myocardial viability; dobutamine-stress echocardiography

J Nucl Med 1998; 39:1845–1850

In patients with chronic ischemic left ventricular dysfunction, restoration of blood flow results in functional improvement only in those regions containing a sufficient amount of viable myocardium (*1*). Because of the high morbidity of revascularization in such severely sick hearts, accurate identification of the presence and extent of jeopardized myocardium before referral to the surgeon or invasive cardiologist has become an important issue. To achieve this goal, dobutamine-stress echocardiography (*2*) and scintigraphic imaging with either positron- or photon-emitting compounds currently are the most widely used noninvasive techniques.

Using SPECT, the first step usually consists of an evaluation of regional myocardial perfusion using either ^{201}Tl or ^{99m}Tc-sestamibi (*3,4*). Considerable discrepancies are found in the literature regarding the ability of these two agents to identify viable myocardium, some authors consider ^{201}Tl more reliable, (*5*) whereas others find similar accuracies for both, especially when the regional activity of sestamibi is quantified (*6–8*). However, whichever tracer is used, a consensus exists regarding the good association between normal uptake and residual viability in myocardial segments with the resting wall motion abnormalities on the one hand (*6,9*), and the propensity of decreased perfusion to overestimate myocardial scar on the other hand (*9–11*). Therefore, metabolic imaging, especially with ^{18}F-fluorodeoxyglucose (FDG) PET, has been proposed as an additional technique in myocardial segments with decreased perfusion (*12,13*). Iodine-labeled free fatty acid SPECT imaging represents an interesting alternative to ^{18}F-FDG (*14*). The combined use of 15-(p-iodophenyl)-3-(R,S)-methyl pentadecanoic acid (BMIPP) and a perfusion tracer (either ^{201}Tl or ^{99m}Tc-sestamibi) has been accurate regarding viability assessment in the acute or subacute phase of myocardial infarction (*15–18*). However, less is known about its value in older infarctions. Nevertheless, Tamaki et al. (*19*) reported that, despite a significantly lower frequency of discordant uptake between BMIPP and ^{201}Tl after the first 4 wk of acute myocardial infarction, the presence and number of discordant segments were the best predictors of future cardiac events in old infarctions (*20*).

Assuming that a mismatch between fatty acid and perfusion could identify chronically ischemic, but viable myocardium, we evaluated the accuracy of combined BMIPP and sestamibi SPECT to detect residual viability in chronically dysfunctional myocardial segments compared with low-dose dobutamine-stress echocardiography (LDDE).

MATERIALS AND METHODS

Patient Population

Twenty-five patients (21 men, 4 women; mean age 61.8 ± 9.5 yr) were included in the study. All had suffered from at least one myocardial infarction (MI) based on documented clinical, enzymatic and electrocardiographic criteria at the time of the acute event. On resting electrocardiography (ECG), 28 persistent Q-wave abnormalities were observed (anterior derivations in 7 patients, anteroseptal in 10, inferior in 7, anterolateral in 2 and lateral in 2). Most patients presented with severe left ventricular dysfunction (mean ± s.d. ejection fraction value at the time of the tests: 33.3% ± 9.5%), 18 of them complained of stress angina, 4 of rest angina and 8 had symptoms of congestive heart failure. Two patients had previous coronary bypass surgery, and 4 had percutaneous transluminal coronary angioplasty. Delay between the most recent MI and the tests ranged between 2 wk and 15 yr, with a median of 3.6 mo. Using 50% stenosis of one of the major epicardial arteries or of the main side branches on coronary angiography as the criterion of significance for coronary artery disease, there were 4 patients

Received Oct. 30, 1997; revision accepted Jan. 28, 1998.
For correspondence or reprints contact: Anne-Sophie E. Hambÿe, MD, Department of Nuclear Medicine, Middelheim Hospital, Lindendreef 1, 2020 Antwerp, Belgium.

with one-vessel, 14 with two-vessel and 7 with three-vessel disease. All patients were stable at the time of the study. None had severe arrhythmia or conduction disturbances on ECG.

Study Design

Patients were referred for coronary angiography because of angina or ischemic heart failure in order to evaluate the technical feasibility of revascularization. Within 1 wk of the procedure, baseline and LDDE, as well as BMIPP and sestamibi studies were performed (the last two with a 3-day interval) to document the presence and extent of viable myocardium. In 6 patients, the complete study was repeated after 6 mo. Mean difference in ejection fraction value between the two tests in these patients was 1.6% ± 1.8%. All patients received written information about the study and gave informed consent. The study protocol was approved by the Commission of Medical Ethics of the Hospitals of Antwerp. Because of the extensive data available on the value of LDDE in the assessment of viability, this method was considered as the gold standard.

Scintigraphy

Radioiodination of BMIPP was done at the Free University of Brussels, Belgium using ^{123}I (p, 5n) and the Cu(I)-assisted isotopic exchange reaction developed by Mertens et al. (*21*). With patients in resting condition, ^{123}I-BMIPP was intravenously injected at a mean dose of 163 MBq (4.4 mCi) after at least a 6-hr fast. Potassium perchlorate was administered 15 min before injection to block thyroidal uptake of free iodine. Scatter-corrected BMIPP SPECT imaging was started 30 min postinjection using a triple-head gamma camera (Triad; Trionix Lab, Twinsburg, OH) equipped with all-purpose, low-energy collimators. Ninety projections (30 per head) of 60-sec duration were acquired over a 360° noncircular body-contour orbit using a 128 × 64 matrix. The photopeak image was acquired with the photopeak set at 159 keV and a window between 143 and 175 keV. A scatter image was acquired in a second window between 116 and 142 keV.

Scatter-corrected, resting ^{99m}Tc-sestamibi SPECT was started at a mean time of 83 min postinjection of 947 MBq (25.6 mCi) using a similar protocol as that for BMIPP but with 40-sec acquisition time per projection and different photo- and scatterpeak characteristics (photopeak set at 140 keV with a window between 126 and 154 keV; scatter window between 100 and 125 keV). No attenuation correction was applied.

Low-Dose Dobutamine-Stress Echocardiography

Two-dimensional transthoracic echocardiography was performed with a commercially available system (Sonos 2500; Hewlett-Packard, Andover, MA) equipped with a 2.5-MHz transducer. Patients were positioned in the left oblique lateral decubitus position, and the four standard views (left parasternal long- and short-axis and apical four- and two-chamber views) were obtained at baseline and during intravenous infusion of 5 and 10 μg/kg/min dobutamine under continuous blood pressure and 12-lead ECG monitoring. The minimum duration of each step was 5 min. Resting and dobutamine images were digitized on-line with an ECG triggering and arranged in a quad-screen, continuous cine-loop display (Image View DCR; Nova-Microsonics, Mahwah, NJ) for side-by-side analysis before being stored on videotape.

The left ventricle was divided into eight segments (anterobasal, anterolateral, anteroseptal, apical, posterolateral, posteroseptal, diaphragmatic and posterobasal). For each segment, systolic thickening and inward wall motion were graded semiquantitatively as normal, hypokinetic, akinetic or dyskinetic by an experienced observer unaware of the scintigraphic results. Viability was defined as an improvement of at least one grade during dobutamine infusion in a segment with impaired resting wall motion. Intraobserver reproducibility, assessed for each stage of the test with a 6-mo interval, was 95%.

Processing and Analyzing Scintigraphic Data

Images were compensated for scatter using a substraction method with k values for compensation of 0.7 for ^{99m}Tc and 1.0 for ^{123}I, as previously reported (*22*). Three standard orthogonal tomograms were then obtained after filtered backprojection and appropriate reorientation of the scatter-corrected data using a Butterworth prefilter (cutoff frequency 0.75 cyc/cm for sestamibi and 0.6 cyc/cm for BMIPP, order 5) and a ramp backprojection filter.

For both studies, the left ventricular myocardium was divided into eight segments matching echocardiography (Fig. 1). After independent normalization of each study to its own maximum, BMIPP and sestamibi uptake were graded on a side-by-side display by two observers unaware of each other or of the clinical and echocardiographic data.

First, the mean uptake in each segment was semiquantitatively expressed in percentage of the maximum for each tracer separately using a 10-step, color-coded scale. The correlation coefficient between the percentage uptake estimated by the two observers was 0.69 (mean interobserver difference 10%, $p = 0.25$). Second, because the number of segments corresponding to each 10% increment in sestamibi uptake was quite small, they were grouped into three categories according to the severity of the perfusion defect. A normal pattern was defined as > 50% of the maximum activity for the posteroseptal, diaphragmatic and posterobasal segments; > 70% for the posterolateral segment; and > 60% for the remaining segments. A moderate defect was defined as 30%–50% of the maximum for the first three segments, 50%–70% for the posterolateral and 40%–60% for the remaining segments and a severe defect as an uptake below these latter values. Finally, the uptake of both tracers was compared on a segmental basis and classified as normal, matched, mismatched or reverse mismatched. A segmental uptake of BMIPP of at least 10% lower than sestamibi was considered mismatching, the segments showing the same decreased uptake with both tracers being described as matched, and those with a BMIPP uptake >10% higher than sestamibi as reverse mismatched. Agreement between the observers was 77% (kappa-0.63). Discrepancies were resolved by consensus after reviewing the images.

Statistical Analysis

All statistical analyses were performed using the SPSS (SPSS Inc., Chicago, IL) statistical program package. Values were expressed as median and range for nongaussian distribution or as mean ± s.d. otherwise. The differences between the proportions of matched and mismatched defects in relation to wall motion were calculated by Fisher's exact test or the chi-square test, when appropriate. Agreement between categorical assessments was evaluated by kappa calculation. A p value < 0.05 was considered significant.

RESULTS

Wall Motion, Sestamibi and BMIPP Uptake at Rest

Image quality was considered echocardiographically adequate in 244 of 248 segments, 130 of which showed resting wall motion abnormalities. The number of abnormal segments averaged 4.2 ± 2.4 per patient (range 1–8). Among these 130 segments, sestamibi uptake was normal in 42, moderately decreased in 59 and severely decreased in 29. Using BMIPP, normal uptake was noted in 21 segments, mismatch in 66 (21 of them with normal perfusion), match in 40 and reverse mismatch in 3 (in one patient, echocardiographically determined to be akinetic). Because a relationship has been suggested between reverse mismatch and hibernation (*16*), the 3 segments with

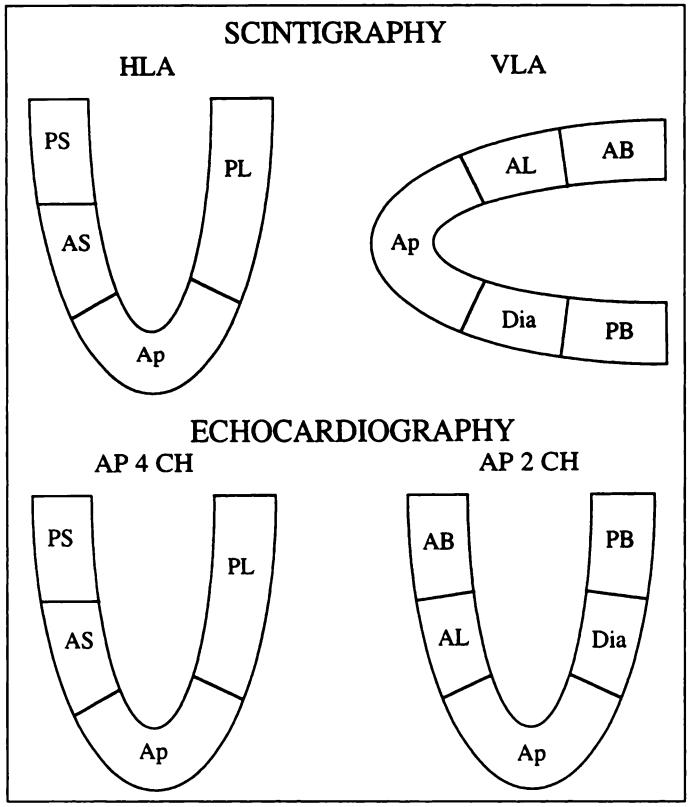

FIGURE 1. Segmentation of left ventricle by SPECT and echocardiography. (Top) Horizontal (HLA) and vertical (VLA) long-axis midventricular views. (Bottom) Apical four- (AP 4 CH) and two-chamber views (AP 2 CH). PS = posteroseptal; AS = anteroseptal; Ap = apical; PL = posterolateral; AB = anterobasal; AL = anterolateral; Dia = diaphragmatic; and PB = posterobasal.

such a pattern were considered viable and added to the mismatched segments for further analysis. No significant relationship was found between the severity of the resting wall motion abnormalities and the presence of mismatch (noted in 34 of 55 hypokinetic segments versus 35 of 75 akinetic segments, $p = 0.09$). On the other hand, a highly significant association was found between a matched decreased uptake and the severity of wall motion abnormalities (6 of 55 hypokinetic segments versus 34 of 75 akinetic segments, $p < 0.001$).

Relationship Between Contractile Reserve, Sestamibi and BMIPP Uptake

Under dobutamine infusion, wall motion improved in 70 of 130 segments. No relationship was observed between the degree of coronary stenosis and the presence of inotropic reserve.

Positive LDDE was observed in 37 of 42 segments (88%) with normal sestamibi uptake versus 33 of 88 segments (38%) with impaired uptake ($p < 0.001$). Hence, abnormal sestamibi uptake was only mildly predictive of negative LDDE (63%), even when the severity of the perfusion defect was quantified because 25 of 59 segments (42%) with moderately decreased and 8 of 29 (28%) with severely decreased uptake were LDDE viable ($p = 0.18$).

Because of the highly positive association between normal sestamibi uptake and the presence of contractile response to dobutamine, analysis of the significance of mismatch was not performed in the 42 normally perfused segments. In the 88 segments with decreased sestamibi uptake, positive LDDE was found in 28 of 48 segments with mismatch or reverse mismatch versus only 5 of 40 segments with match ($p < 0.001$). However, 20 segments with mismatch were considered nonviable by LDDE. The sensitivities, specificities and predictive values of sestamibi separately and in combination with BMIPP are reported in Table 1.

Global agreement between LDDE and scintigraphy was 77% (kappa = 0.52). Normal sestamibi uptake or mismatch between BMIPP and sestamibi was 72% predictive of positive LDDE, and a matched decrease of both tracers was 88% predictive of negative LDDE.

Relationship Between Contractile Reserve, Sestamibi and BMIPP Uptake According to Severity of Wall Motion Abnormalities

Hypokinesis was observed in 55 segments, 50 of which (91%) were LDDE positive. Normal sestamibi uptake or mismatch was noted in 45 of the 50 LDDE-positive segments (90%), and the global agreement between the two approaches was 84% (Table 2).

Akinesis or dyskinesis was observed in 75 segments, 20 of which (27%) showed evidence of contractile reserve ($p < 0.001$

TABLE 1
Sensitivity, Specificity, Positive and Negative Predictive Values in Viability Assessment

Value	Sestamibi (%)	Combined sestamibi and BMIPP (%)
Sensitivity	53	93
Specificity	92	58
Positive predictive value	88	72
Negative predictive value	63	88

BMIPP = 15-(p-iodophenyl)-3-(R,S)-methyl pentadecanoic acid.
Dobutamine echocardiography was considered the gold standard.

TABLE 2
Relationship Between Sestamibi and BMIPP Uptake and Inotropic Reserve According to Severity of Resting Wall Motion Abnormalities

	BMIPP and sestamibi uptake			
	Hypokinetic (n = 55)		Akinetic/dyskinetic (n = 75)	
Result	Normal or mismatch	Match	Normal or mismatch	Match
LDDE +	45	5	20	0
LDDE −	4	1	21	34
Total	49	6	41	34

LDDE + = low-dose dobutamine echocardiography positive test; LDDE − = low-dose dobutamine echocardiography negative test; BMIPP = 15-(p-iodophenyl)-3-(R,S)-methyl pentadecanoic acid.

versus hypokinetic segments). Sestamibi uptake was decreased in 64 segments (85%, $p < 0.001$ versus hypokinetic segments), and the positive and negative predictive values of sestamibi with regard to viability were 55% and 78%, respectively. In the segments with impaired uptake, the accuracy of sestamibi to differentiate viable from scar tissue significantly improved by quantifying the severity of the perfusion defect, 6 of 11 segments (55%) had normal uptake, 11 of 40 (28%) had moderately decreased uptake and only 3 of 24 (13%) had severely decreased uptake being LDDE positive ($p = 0.033$). Normal sestamibi uptake or mismatch was 49% predictive of residual inotropic reserve (20 of 41 segments), and match was 100% predictive of the absence of response to dobutamine (34 of 34 segments, $p < 0.001$, Table 2). Agreement between the two approaches in severely asynergic segments was 72% (kappa = 0.46).

In this group of akinetic segments, analysis of the comparative value of BMIPP and sestamibi versus LDDE was repeated, taking into account the age of the infarction (less or more than 6 mo old). Both groups were similar regarding clinical variables. Matched decreased uptake had a 100% negative predictive value in both groups, whereas a higher number of segments with mismatch were considered echocardiographically nonviable in the more than 6-mo old group (63% versus 41%, $p = 0.16$, Table 3), resulting in a lower positive predictive value in this group and, hence, a lower agreement rate (78%, kappa = 0.57 for the less than 6-mo group versus 65%, kappa = 0.34 for the more than 6-mo group).

TABLE 3
Relationship Between Sestamibi and BMIPP Uptake and Inotropic Reserve in Akinetic or Dyskinetic Segments According to Delay Between Acute Event and Tests

	BMIPP and sestamibi uptake			
	< 6 mo old (n = 41)		> 6 mo old (n = 34)	
	Normal or mismatch	Match	Normal or mismatch	Match
LDDE +	13	0	7	0
LDDE −	9	19	12	15
Total	22	19	19	15

LDDE + = low-dose dobutamine echocardiography positive test; LDDE − = low-dose dobutamine echocardiography negative test; BMIPP = 15-(p-iodophenyl)-3-(R,S)-methyl pentadecanoic acid.

DISCUSSION

Three main patterns of regional activity of sestamibi and BMIPP were noted in patients with chronic ischemic left ventricular dysfunction and impaired regional wall motion: normal perfusion, discordant (mismatched) and concordant (matched) decreased uptake. Two-thirds of the segments with normal sestamibi uptake or mismatch showed residual inotropic reserve during dobutamine infusion. In contrast, almost all the segments with matched defects did not demonstrate any response to dobutamine. These findings, quite similar to those reported in acute or subacute infarctions (*15*), indicate that metabolic/perfusion imaging could be useful in identifying myocardial viability even later in the course of the disease.

Free Fatty Acid Metabolism

Initial uptake of BMIPP depends primarily on regional blood flow. After transport into the cell through a membrane fatty acid-binding protein (*23*), most of the BMIPP undergoes the adenosine triphosphate-dependent initial steps of the native fatty acid enzymatic activation to acyl-coenzyme A (CoA) (*24*) before being incorporated in the endogenous lipid pool (*14*), while a small amount is backdiffused. Afterward, a significant proportion of BMIPP-CoA is beta-oxidized in the mitochondria through an intermediate alpha-oxidation step, despite the presence of the methyl group (*25*). This catabolic chain is probably responsible for the 5.6%–13.0% washout observed in clinical studies between 20 min and 3 hr postinjection at rest (*26*). In pathological conditions with impaired myocardial oxygen supply, alteration of the usage of fatty acids as energy substrates for the production of high-energy phosphate might result in increased backdiffusion of BMIPP and decreased tissue concentration of BMIPP and alpha-oxidized metabolites, hence mismatching with the flow tracers. Thus, imaging with BMIPP might provide information regarding the metabolic state of the myocardium regardless of perfusion status.

Sestamibi Uptake Analysis

Normal sestamibi uptake was 88% positive predictive for residual inotropic activity, whereas decreased uptake was only a 63% negative predictor of no response to dobutamine. These results, quite similar to those of Altehoefer et al. (*9*) who found that a cutoff value of 60% sestamibi uptake was 88% positive but only 40% negative predictive of viability compared with ^{18}F-FDG PET, confirm the rather poor negative predictive value of decreased regional uptake of sestamibi with regard to viability (*5,9,11*), at least without nitrate administration, which has been shown to improve the accuracy of sestamibi imaging (*27*).

Quantifying the severity of the perfusion defect was helpful in differentiating between resting hypokinesis and akinesis as well as to improve the negative predictive value of resting sestamibi in akinetic segments. This observation confirms previous findings that a severe perfusion defect quite accurately identifies myocardial scar in akinetic or dyskinetic myocardium, but that additional metabolic imaging is recommended in the case of moderate defect to differentiate viable from necrotic tissue (*9*).

Additional Value of BMIPP

In acute myocardial infarction, the addition of free fatty acid metabolic imaging to a perfusion study has been reported to significantly improve the detection of viability (*15–18*). It has been postulated that myocardial regions with discordant BMIPP uptake related to perfusion represent jeopardized tissue, in which a metabolic shift from fatty acid to less oxygen-consuming glucose utilization has occurred. In such myocar-

dium, future ischemic events are more likely to happen if treatment is conservative (*20*). This study demonstrates that the different distribution patterns noted in recent myocardial infarction can be reproduced in the chronic phase. Because of the high correlation between normal sestamibi uptake and viability in segments with resting abnormal wall motion (*6,9*), we did not analyze the significance of mismatch in those segments, assuming that they probably represented severely ischemic, but viable myocardium (*28*), in which the addition of BMIPP would not be expected to significantly alter the accuracy of the test.

In the segments with abnormal sestamibi uptake, BMIPP significantly improved the agreement with echocardiography, particularly in the akinetic group in which 85% of the segments showed an uptake of less than 60% and would have been considered nonviable by sestamibi alone. In these segments, a matched decreased uptake could rule out viability with 100% accuracy. On the other hand, a mismatched pattern had only a mild positive predictive value, because approximately half of the segments with such a pattern were classified as nonviable by echocardiography. Interestingly, the relationship between discordant BMIPP and sestamibi uptake and residual inotropic reserve in akinetic segments was not significantly related to the delay between the acute event and the tests, suggesting that BMIPP and perfusion imaging might identify myocardial viability regardless of the age of the infarction.

Contractile Reserve in Relation to Scintigraphic Findings

Despite good agreement between the two methods, one-third of the mismatched segments were echocardiographically nonviable during low-dose dobutamine stimulation. This discordance was primarily observed in akinetic segments and has also been noted by others (*7,29*). Several explanations have been proposed for these discrepancies.

First, the absence of residual inotropic reserve under dobutamine could be caused by the severity of the stenosis, precluding any increase in wall motion or even inducing a worsening under very small inotropic stimulation (*30*). Conversely, the dose of 10 μg/kg/min dobutamine usually recommended for echocardiographic studies of viability might have been insufficient to induce inotropic stimulation in some cases. It has recently been demonstrated in a canine model that the dose of dobutamine needed to induce thickening of the postischemic myocardium is related directly to the amount of necrosis and that 15 μg/kg/min might be the optimal dose to identify the extent of viable myocardium (*31*).

Second, the cellular mechanisms responsible for a positive response to adrenergic stimulation require a higher degree of myocyte functional integrity and are probably downregulated for less severely decreased flow rates than those responsible for the transmembrane pump activity or mitochondrial membrane integrity, which are critical for the maintenance of myocyte viability (*32*).

Third, it is plausible that many akinetic segments represent an admixture of scar, jeopardized and normal tissue in various amounts. Because the endocardial half of the myocardium is the major contributor to wall motion, severe endocardial hypoperfusion will result in transmural akinesis despite preserved midwall and epicardial flow (*33*). However, revascularization of such segments corresponding to jeopardized tissue has been shown to improve long-term prognosis and reduce subsequent ischemic events, even in the absence of improvement in resting regional function (*33*). Mismatch between perfusion and metabolism, indicating jeopardized tissue, might be used to identify those segments.

Fourth, most studies comparing stress echocardiography with radionuclide methods have their follow-up based on resting echocardiography performed a short time after revascularization. This can underestimate the true degree of functional recovery, especially in the segments with prolounged ischemia, in which cellular dedifferentiation and loss of contractile material may require a longer recovery period (*1*) and could explain the higher number of segments with mismatch and negative stress echocardiography observed in infarctions more than 6-mo old.

Finally, technical limitations such as poor image quality, absence of complete anatomical concordance, motion artifact, observer's experience and lack of quantification of echocardiography should also be considered.

Study Limitations

One of the limitations inherent to the comparison of two different approaches is the lack of complete anatomical concordance between a two-dimensional and a three-dimensional method. In this study, in which the SPECT segments were matched with the echocardiography, this can lead to some discordances in the location of the abnormalities. However, the good interobserver agreement in the denomination of the segments and in their classification as normal, mismatched or matched makes it unlikely that the conclusions were greatly influenced by this feature.

Another limitation is the limited number of patients studied and the lack of follow-up data, whereby the results of the scintigraphic method are inferred from those of the stress echocardiography.

Finally, the patient group is heterogeneous regarding the delay between the acute event and the tests. However, because the differences between less than and older than 6-mo old akinetic segments were not statistically significant, it is unlikely that the heterogeneity of the infarction age had a major effect on the results.

CONCLUSION

In chronic ischemic left ventricular dysfunction, combined analysis of resting BMIPP and sestamibi uptake accurately predicts the response to dobutamine stimulation in myocardial segments with impaired resting wall motion and is more sensitive than sestamibi alone to differentiate between viable and scar myocardium. Diagnostic accuracy is similar to that reported early after acute infarction, suggesting that the presence of discordant fatty acid or perfusion uptake is not significantly correlated with the age of the infarction.

ACKNOWLEDGMENTS

We thank A. Vervaet, MSc for her help with the statistical analysis; P. Vermeersch, V. Van Schuylenbergh, M. Vandermotte, C. Convens, D. Stockman, M. Derveaux, P. Surmont, E. Vanagt, S. Lieber, R. Baluwe and F. Van den Branden, cardiologists, for their enthusiasm in referring patients; and J. Vandevivere, department head of nuclear medicine of Middelheim Hospital, for his support.

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Effect of Oral Glucose Loading on the Biodistribution of BMIPP in Normal Volunteers

Frank De Geeter, Vicky Caveliers, Ingrid Pansar, Axel Bossuyt and Philippe R. Franken
Department of Nuclear Medicine, University Hospital, Free University Brussels, Brussels, Belgium

We have evaluated whether myocardial uptake of the fatty acid analog ^{123}I-15-(p-iodophenyl)-3-R,S-methyl pentadecanoic acid (BMIPP) is dependent on the dietary state. **Methods:** We compared the biodistribution of 150 MBq of ^{123}I-BMIPP in six healthy volunteers in two states: after at least 12 hr of fasting and after oral glucose loading (75 g) 60 min before tracer administration, followed by a meal enriched in carbohydrates and protein. Planar and tomographic acquisitions were performed over a 4-hr time period after tracer injection; data were corrected for radioactive decay and injected dose. Radioactivity was measured in blood samples drawn at several points. **Results:** Significant increases of glycemia and insulinemia and a significant drop in plasma nonesterified acids were documented after glucose loading. Half-time values for plasma radioactivity were significantly shorter in the glucose-loaded state than in the fasted state (4.3 ± 1.4 min compared to 6.3 ± 1.3 min, $p < 0.05$). Activity in the heart and liver tended to be higher in the glucose-loaded state than in the fasted state. SPECT images at 0.5 hr after tracer injection demonstrated that the myocardial wall-to-cavity ratio was higher after glucose than in the fasted state (2.53 ± 0.59 compared to 2.11 ± 0.21, $p = 0.15$). Washout from the liver between 1 and 4 hr after injection increased from 18.6% ± 4.4% in the fasted study to 24.1% ± 2.4% after glucose ($p = 0.04$). Washout from the myocardium between 0.5 and 3.5 hr after injection increased from 13.1% ± 8.8% in the fasted study to 24.0% ± 3.7% after glucose ($p = 0.05$). **Conclusion:** These results indicate that fasting before BMIPP scintigraphy is not mandatory to obtain adequate SPECT images. At the time when SPECT is usually performed, glucose loading may provide improved ratios between myocardial and blood pool activity.

Key Words: 15-(p-iodophenyl)-3-R,S-methyl pentadecanoic acid; glucose; biodistribution

J Nucl Med 1998; 39:1850–1856

The clinical utility of ^{123}I-labeled 15-(p-iodophenyl)-3-R,S-methyl pentadecanoic acid (BMIPP) in cardiomyopathy as well as in ischemic heart disease has been documented extensively (*1,2*). In ischemic heart disease, evidence has accumulated that myocardial areas in which the uptake of BMIPP is diminished

Received Oct. 1, 1997; revision accepted Feb. 12, 1998.
For correspondence or reprints contact: Frank De Geeter, MD, Department of Nuclear Medicine, AZ-VUB, Laarbeeklaan 101, B-1090 Brussels, Belgium.