This study assessed the value of dobutamine 201TI scintigraphy for detecting significant disease of infarct-related and remote coronary arteries in myocardial infarction patients. Methods: Dobutamine (up to 40 µg/kg/min)/atropine (up to 1 mg) stress test in conjunction with stress-reinjection 201TI SPECT was performed in 71 symptomatic patients with left ventricular dysfunction >3 mo after myocardial infarction. Ischemia was defined as reversible perfusion defects. Results: Significant coronary artery stenosis (≥50% luminal diameter stenosis) was detected in all patients. Sensitivity, specificity and accuracy of regional ischemia for the diagnosis of remote coronary artery stenoses were 74% (95% CI 63–86), 80% (CI 70–90) and 76% (CI 65–87), respectively. Those for infarct-related artery stenoses were 71% (CI 60–81), 83% (CI 75–92) and 72% (CI 61–82), respectively. Ischemic perfusion score was higher in patients with multi-versus single-vessel disease (1056 ± 1021 versus 423 ± 633, p < 0.01). Conclusion: Dobutamine thallium scintigraphy is valuable for assessing the extent of coronary stenosis on the basis of reversible hypoperfusion in symptomatic patients late after myocardial infarction.

Key Words: dobutamine stress test; thallium-201 SPECT; myocardial infarction


Exercise 201TI perfusion scintigraphy is a widely used technique for the diagnosis and functional assessment of coronary artery disease (1–4). The presence of scintigraphic markers of myocardial ischemia after myocardial infarction, based on reversible hypoperfusion, is a predictor of future cardiac events (3,4).

Since exercise tolerance may be reduced in patients with left ventricular dysfunction, dobutamine stress testing represents a feasible and safe alternative (5–11). However, in the presence of severe myocardial dysfunction and severe perfusion abnormalities at rest, the detection of reversible perfusion defects represents a technical challenge for thallium scintigraphic techniques (12,13). Conversely, a study of patients after a recent myocardial infarction has shown that the prevalence of ischemia on dobutamine thallium scintigraphy is higher in peri-infarction compared to remote regions subtended with stenotic coronary arteries (14). Accordingly, we attempted to assess the value of dobutamine 201TI SPECT imaging for the diagnosis of infarct-related and remote coronary artery disease in symptomatic patients with left ventricular dysfunction late after acute myocardial infarction based on the presence of reversible hypoperfusion. We also wanted to assess the extent to which the severity of persistent perfusion abnormalities influence the occurrence of an ischemic response in individual myocardial regions subtended with stenotic coronary arteries.
MATERIALS AND METHODS

Patients

We studied 71 patients with chronic coronary artery disease and limited exercise capacity who were referred to our nuclear imaging laboratory for evaluation of myocardial ischemia and who fulfilled the following criteria:

1. Previous Q-wave myocardial infarction \( \geq 3 \) mo. The diagnosis of myocardial infarction relied on the standard criteria of prolonged chest pain, a diagnostic rise (at least twice the normal value) and fall of serum creatine kinase and serial electrocardiographic changes. Mean time from the infarction was \( 5.3 \pm 6.1 \) yr. Fifty patients (70%) received thrombolytic therapy in the acute phase of infarction.

2. Presence of wall-motion abnormalities on resting echocardiogram.

3. Absence of left bundle branch block, left ventricular hypertrophy, severe heart failure, valvular heart disease, severe hypertension, hypotension or a history of sustained ventricular tachyarrhythmias.

All patients gave informed consent to undergo dobutamine stress testing in conjunction with \(^{201}\)Tl perfusion scintigraphy. Mean age was \( 59 \pm 9 \) yr. There were 58 men and 13 women. Forty-seven (66%) patients were receiving oral nitrates and/or calcium antagonists and 38 patients (54%) were receiving angiotensin-converting enzyme inhibitors on the day of the test. Beta-blocking agents were stopped 2 days before the test. Symptoms before testing included typical angina in 57 patients, atypical chest pain in 3 patients and exertional dyspnea in 25 patients. Myocardial infarction was anterior (or anterolateral) in 39 patients, inferior (or inferolateral) in 20 patients and combined anterior and inferior in 12 patients.

The site of infarction was determined by the location of Q-waves in the electrocardiogram and wall motion abnormalities on resting echocardiograms.

Dobutamine was infused through an antecubital vein starting at a dose of 5 \( \mu \)g/kg/min followed by 10 \( \mu \)g/kg/min (3-min stages), increasing by 10 \( \mu \)g/kg/min every 3 min to a maximum of 40 \( \mu \)g/kg/min. Atropine (up to 1 mg) was administered to patients not achieving 85% of age-predicted maximal heart rate (15). The ECG was monitored during dobutamine infusion and a 12-lead ECG was recorded every minute. Cuff blood pressure was measured every 3 min. The test was interrupted if severe chest pain, ST-segment depression \( > 2 \) mm, significant ventricular or supraventricular arrhythmia or systolic blood pressure fall \( > 40 \) mmHg occurred during the test. Ischemia on the ECG was defined as \( \geq 0.1 \) mV horizontal or downsloping ST-segment depression \( 80 \) mV from the J point compared to baseline level or \( \geq 0.1 \) mV ST-segment elevation in ECG leads corresponding to myocardial regions without infarction (16).

Echocardiography

A baseline echocardiogram was performed the same day of the scintigraphic study. The two-dimensional echocardiograms were performed with the patient in the left lateral decubitus position using a commercially available system. Images were acquired in the standard apical and parasternal views. The left ventricular wall was divided into 16 segments and scored using a 4-point scale, with the higher score denoting more severe contraction abnormalities, where 1 = normal, 2 = hypokinesis, 3 = akinesis and 4 = dyskinesis (16). Both wall motion and thickening were considered for analysis. The wall motion score index was derived by dividing the summation of the score of the 16 segments by 16. The regional wall motion score index was derived by dividing the score of the segments in each vascular territory by the number of segments in that territory.

Thallium SPECT Imaging

Myocardial perfusion was assessed using dobutamine stress injection immediately followed by imaging and then, 4 hr later, thallium rest reinjection and imaging 20 min later. Approximately 1 min before the termination of the stress test, an intravenous dose of \( 74 \) MBq \(^{201}\)Tl was administered (17). Stress SPECT images were acquired immediately after the rest test. For the reinjection studies, images were acquired 4 hr after the stress test, 20 min after the reinjection of \( 37 \) MBq \(^{201}\)Tl. For each study, six oblique (short-axis) slices from the apex to the base and three sagittal (vertical long-axis) slices from the septum to the lateral wall were defined. Each of the six short-axis slices was divided into eight equal segments. The interpretation of the scan was performed by visual analysis, assisted by the circumferential profiles analysis. All tomographic views were reviewed in side-by-side pairs (stress and reinjection) by an experienced observer who was unaware of the patients' clinical or angiographic data. The thallium uptake of each segment was graded semiquantitatively using a five-point scoring method (0 = normal, 1 = slightly reduced, 2 = moderately reduced, 3 = severely reduced, 4 = absent uptake). A reversible perfusion defect was defined as the perfusion defect on stress images that partially or completely resolved at reinjection imaging in two or more contiguous segments or slices. This was considered diagnostic of ischemia. A fixed perfusion defect was defined as a perfusion defect on stress images in two or more contiguous segments or slices which persists on reinjection images. To assess perfusion defect size quantitatively, the perfusion defect score was calculated by measuring the area between the lower limit of normal values (\( \pm 2 \) s.d.) and the actual circumferential profile of the patient at reinjection and stress images. Thus, a score of 0 indicates normal perfusion and the larger the defect score, the more severe the perfusion defect. The ischemic perfusion score was derived by subtracting the rest from the stress score in segments with reversible defects. Reinjection (fixed) defect score was compared in vascular territories with and without reversible perfusion defects in the presence of significant stenosis of the related artery.

Coronary Angiography

Coronary angiography and left ventriculography were performed, using the Judkins technique, within 3 mo of dobutamine stress testing in all patients. Coronary artery lesions were quantified as discussed previously (18). Significant coronary artery disease was defined as a diameter stenosis \( \geq 50% \) in one or more major epicardial arteries. Coronary arteries were assigned to particular myocardial segments as follows: (a) the left anterior descending (LAD) coronary artery was assigned to the anterior wall, anterior septum, posterior septum (except for the basal segment), apical anterior and apical septal segments; (b) the left circumflex (LCX) coronary artery was assigned to the lateral and posterior wall; and (c) the right coronary artery (RCA) was assigned to the inferior wall and the basal part of the posterior septum. The apical lateral segment was considered as an overlap segment between the LAD and the LCX and was assigned to the abnormal artery. Similarly, the apical inferior segment was considered as an overlap segment between the LAD and RCA. Peri-infarct area was defined as myocardial segments in the distribution of infarct-related artery.

Unless specified, data are presented as mean values \( \pm \) s.d. The chi square test was used to compare differences between proportions. The Student’s t-test was used for analysis of continuous data. A \( p < 0.05 \) was considered statistically significant. Sensitivity, specificity, predictive value and accuracy were derived according to standard definition and presented with their corresponding 95% confidence interval (CI).
TABLE 1
Sensitivity, Specificity and Accuracy of Reversible Perfusion Defects on Dobutamine Thallium-201 Scintigraphy for Diagnosis of Significant Stenosis in Individual Regions in Patients with Previous Myocardial Infarction

<table>
<thead>
<tr>
<th>Region</th>
<th>Yes (No. of patients)</th>
<th>No (No. of patients)</th>
<th>Sensitivity % (95% CI)</th>
<th>Specificity % (95% CI)</th>
<th>Accuracy % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left anterior descending</td>
<td>62</td>
<td>9</td>
<td>65 (53–76)</td>
<td>89 (81–96)</td>
<td>68 (57–79)</td>
</tr>
<tr>
<td>Left circumflex</td>
<td>46</td>
<td>25</td>
<td>61 (50–72)</td>
<td>76 (66–86)</td>
<td>66 (55–77)</td>
</tr>
<tr>
<td>Right coronary artery</td>
<td>52</td>
<td>19</td>
<td>67 (56–78)</td>
<td>74 (63–84)</td>
<td>69 (58–80)</td>
</tr>
<tr>
<td>Right coronary artery ± left circumflex</td>
<td>61</td>
<td>10</td>
<td>74 (64–84)</td>
<td>80 (71–89)</td>
<td>75 (65–85)</td>
</tr>
<tr>
<td>Infarct-related artery</td>
<td>65</td>
<td>6</td>
<td>71 (60–81)</td>
<td>83 (75–82)</td>
<td>72 (61–82)</td>
</tr>
<tr>
<td>Remote coronary artery</td>
<td>39</td>
<td>20</td>
<td>74 (63–86)</td>
<td>80 (70–90)</td>
<td>76 (65–87)</td>
</tr>
</tbody>
</table>

RESULTS

Coronary Angiography

Significant coronary artery disease was detected in all patients. Ten patients (14%) had single-vessel disease, 33 (46%) had two-vessel disease and 28 (39%) had three-vessel disease. Significant stenosis of the LAD was detected in 62 patients (87%), of the RCA in 52 patients (73%) and of the LCX in 46 patients (65%). Significant stenosis of the LCX and/or RCA was detected in 61 patients (86%). In stenotic coronary arteries, the mean percentage diameter stenosis was significantly higher in infarct-related than remote coronary arteries (78 ± 21 versus 62 ± 25%, p < 0.05). The mean left ventricular ejection fraction determined by contrast ventriculography was 38 ± 11%.

Dobutamine Stress Test

Heart rate increased from 72 ± 13 bpm at rest to 139 ± 15 bpm at peak stress (p < 0.0001), whereas systolic blood pressure did not change (125 ± 21 mmHg at rest versus 123 ± 25 mmHg at peak stress). Atropine was administered to 27 (38%) patients. Angina occurred in 41 (58%) patients and ST-segment depression occurred in 24 (32%), of whom 2 had one-vessel and 22 had two-vessel disease. ST-segment elevation occurred in 32 patients (44%), and all of them had resting wall motion abnormalities in the related segments.

The test was interrupted before reaching the maximal dose or the target heart rate due to angina in five patients, ST-segment depression in one patient, hypotension in eight patients and significant tachyarrhythmias in one patient.

Thallium-201 SPECT

All patients had abnormal perfusion scintigraphy (fixed perfusion defect in the infarct region with or without concomitant reversible perfusion defects in the peri-infarct or remote regions). Ischemia (partially or completely reversible perfusion defects) was detected in 57 patients (80%). There was no significant difference between patients with or without ischemia with respect to mean ejection fraction (40 ± 13% versus 35 ± 10%), peak heart rate (139 ± 13 bpm versus 138 ± 13 bpm) or peak rate-pressure product (16931 ± 3856 versus 17035 ± 3207). The sensitivity of dobutamine 201-Tl scintigraphy for the detection of coronary artery disease, on basis of reversible perfusion defects, was 80% in all patients, 70% in patients with single-vessel disease, 79% in patients with two-vessel disease and 86% in patients with three-vessel disease. Sensitivity was relatively higher in multivessel compared with single-vessel disease (82% versus 70%), though the difference was not statistically significant. The sensitivity was higher than electrocardiography (p < 0.0001). The sensitivity and specificity for the detection of significant stenosis in individual arteries, on the basis of reversible perfusion defects, are shown in Table 1. Because of the overlap between the LCX and RCA in the posteroinferior region, the sensitivity and specificity for detecting stenosis in either arteries also were calculated by combining both vascular territories.

Ischemia was detected in more than one vascular territory in 39 of 61 patients with multivessel disease and in 2 of 10 patients with single-vessel disease (sensitivity for detecting coronary stenosis in >1 region = 64%; CI 53–75, specificity = 80%; CI 71–89 and accuracy = 66%; CI 55–77).

Peri-infarction ischemia was detected in 46 of 65 patients with and in 1 of 6 patients without significant stenosis of the infarct-related artery (sensitivity = 71%; CI 60–81, specificity = 83%; CI 75–92 and accuracy = 72%; CI 61–82). Of the six patients without significant infarct-related artery stenosis, three underwent coronary angioplasty of the infarct-related artery in the first week after the acute infarction.

In the 59 patients who had infarction confined to the anterior or inferior location, remote ischemia was detected in 29 of 39 patients with and in 4 of 20 patients without remote coronary stenosis (sensitivity = 74%; CI 63–86, specificity = 80%; CI 70–90 and accuracy = 76%; CI 65–87 (Table 1). Perfusion scintigraphic images of a patient with old inferior myocardial infarction and three-vessel disease are shown in Figure 1.

Effect of Fixed Wall Motion and Perfusion Abnormalities

In infarct regions subtended by stenotic coronary arteries, the regional quantitative perfusion defect score at reinjection (Fig.

FIGURE 1. (Left) Thallium perfusion images from the mid short-axis level of a male patient with three-vessel disease and old inferior myocardial infarction presented with the corresponding circumferential profile analysis (right), which shows a large perfusion defect in the septum and posteroinferior wall at dobutamine stress images (left column) that was completely reversible in the septum (horizontal arrows) and partially reversible in the posteroinferior wall (vertical arrows) at reinjection images (right columns). A = anterior, S = septum, P = posterior, L = lateral. Clockwise division of the segments in the short-axis slices are numbered 1 and 2. The upper panel is more apical. The dark zone defined by gray lines represents the thallium uptake in normal individuals ±2 s.d. The less dark area defined by white lines represents the area of reduced uptake falling below the normal values ±2 s.d. This area is expressed as unitless numbers representing the perfusion defect score, with a higher score denoting more severe defects. Thus, in the upper panel, the perfusion score was 864 at stress and 179 after reinjection. The fixed perfusion defect score is 179 and the ischemic perfusion defect score is 685 (664–179) at this level of the myocardium.
2) and the regional wall-motion score index on the resting echocardiogram (Fig. 3) were significantly lower in the presence of reversible perfusion defects in the same vascular territory only in the LCX and RCA territories; whereas no difference was found in the LAD territories.

**Relation between Myocardial Perfusion and Function**

The mean wall motion score index was 1.87 ± 0.4 (range 1.13–2.75). There was no significant difference in the wall motion score index between patients with and without reversible perfusion defects (1.84 ± 0.43 versus 1.92 ± 0.23, p = ns). There was a fair correlation between regional wall motion score index and regional quantitative perfusion defect score at reinjection in the LAD territories (r = 0.53), LCX Territories (r = 0.53) and RCA territories (r = 0.48) (Fig. 4).

**Extent and Severity of Ischemia in Single- versus Multivessel Disease**

Patients with multivessel disease had a higher number of segments with reversible perfusion defects (2.5 ± 1.3 versus 1.7 ± 0.9, p < 0.01) and a higher ischemic defect score (1056 ± 1021 versus 423 ± 633, p < 0.01) compared to patients with single-vessel disease.

**DISCUSSION**

The presence of redistribution on exercise thallium scintigraphy after myocardial infarction identifies patients at higher risk of cardiac events (3,4) and represents an important guideline in patient management, particularly when the extent and severity of perfusion abnormalities are considered.

Although the exercise-stress test is the most physiologic method for the induction of myocardial ischemia, the dobutamine stress test appears to be a feasible alternative in patients with limited exercise capacity. The hemodynamic response of dobutamine simulates that of the exercise stress test (19–20). Recent studies have demonstrated the value of dobutamine perfusion scintigraphy in diagnosing and locating coronary artery disease, based on the occurrence of reversible hypoperfusion in patients without previous myocardial infarction (5–11). The role of dobutamine thallium scintigraphy in the assessment of myocardial viability and the prediction of improvement of left ventricular function after revascularization has been previously studied (17). However, little is known about its value in the diagnosis of peri-infarction and remote ischemia in patients with previous myocardial infarction.

The results of our study show good overall sensitivity of dobutamine 201TI SPECT for the diagnosis of significant coronary artery stenosis on the basis of reversible hypoperfu-
In a well-defined patient population with left ventricular dysfunction late after myocardial infarction. The sensitivity for the detection of remote coronary artery stenosis was comparable to that for the infarct-related artery. The relatively low sensitivity for the detection of individual coronary stenosis and multivessel involvement on basis of inducible ischemia in more than one vascular territory can be explained by the possible attenuation of differences in perfusion in presence of multivessel disease and because remote ischemic segments may appear as contiguous. Another explanation is a different threshold for ischemia in different territories in the same patients, with a possibility of reaching an endpoint of symptoms, hemodynamic or electrical changes after the occurrence of ischemia in one territory before others. Exercise thallium scintigraphy was reported to underestimate the extent of coronary artery disease after myocardial infarction (21). Similar findings were reported with adenosine/201Tl (22) and dobutamine99mTc-MIBI (8) in patients without myocardial infarction. The vascular overlap between the LCX and RCA in the postero-inferior region (9,23) may explain the higher accuracy when both arteries were analyzed together.

**Influence of Severity of Resting Perfusion Abnormalities on the Diagnosis of Ischemia**

In the presence of infarct-related artery stenosis, the severity of fixed wall motion and perfusion abnormalities contributed to a lower prevalence of peri-infarct redistribution only in the LCX and RCA territories. The severity of resting abnormalities was not different with or without reversible defects in territories with LAD stenosis. This can be explained by the large myocardial mass in the LAD territories that maintains an adequate substrate for ischemia, even in the presence of a relatively large infarction. This is in contrast to the RCA and LCX that supply a smaller myocardial mass in which the induction of myocardial ischemia may be critically dependent on the extent of intact myocardium. Although the severity of resting perfusion abnormalities was a factor reducing the sensitivity for the diagnosis of significant RCA or LCX stenosis, there was no difference in the sensitivity for the diagnosis of infarct-related and remote coronary stenosis. This can be explained by the more severe diameter stenosis of the infarct-related compared to remote stenosis that may compensate for the reduction of myocardial mass functioning as a substrate for ischemia in the peri-infarction region. Mean ejection fraction was not different with or without ischemia. Similar results were reported by Sutton et al. (24) in patients with residual critical stenosis after thrombolysis for acute myocardial infarction, undergoing exercise thallium scintigraphy. Our findings of a similar peak heart rate and rate-pressure product in patients with or without ischemia are consistent with the findings of Sutton et al. (24).

**Comparison with Previous Studies**

Coma-Canella et al. (14) studied 63 patients with dobutamine 201Tl SPECT early after a recent myocardial infarction. The sensitivity of 201Tl scintigraphy for the detection of coronary stenosis was 75% for infarct-related and 18% for remote coronary arteries. The low sensitivity for remote stenosis, as compared with our results, may be related to their inclusion of an asymptomatic population, whereas the inclusion of symptomatic patients in our study could be expected to influence the inducibility of ischemia. Another factor may be related to the use of quantitative assessment of perfusion in all patients in our study that may enhance the detection of mild reversible defects (25). The higher sensitivity for remote coronary artery stenosis in our study (74% versus 18% in the other study) is concordant with our finding of a higher quantitative ischemic perfusion defect score in patients with multivessel compared with single-vessel disease. Whereas the previous study, based on visual semiquantitative assessment, failed to find such difference. The overall accuracy of dobutamine thallium scintigraphy for the diagnosis of significant coronary artery stenosis in patients with previous myocardial infarction is comparable to previous studies on dobutamine perfusion scintigraphy in patients without previous myocardial infarction (5–11).

**Study Limitations**

All patients had significant coronary artery stenosis precluding evaluation of the overall specificity of the technique. However, coronary stenosis was not an inclusion criterion and this finding represents the high predictive value of the clinical status of this population for significant coronary stenosis. Nevertheless, we have demonstrated good regional specificity of the technique. Although 201Tl reinjection improves the detection of ischemia in dyssynergic segments (12), it has been reported that some reversible defects at redistribution may become fixed after reinjection with a possibility of underestimating ischemia if redistribution images were not acquired (13).

**CONCLUSION**

Dobutamine 201Tl scintigraphy is an accurate method for the diagnosis of remote coronary stenosis based on reversible hyperperfusion in symptomatic patients with left ventricular dysfunction after myocardial infarction. In patients with infarct-related artery stenosis, the severity of fixed wall motion and perfusion abnormalities contributes to a lower prevalence of peri-infarct ischemia only in the LCX and RCA territories, probably due to the smaller myocardial mass as compared to the territories of the LAD.

**REFERENCES**

Pre- and Post-Therapy Thallium-201 and Technetium-99m-Sestamibi SPECT in Nasopharyngeal Carcinoma

Lale Kostakoglu, Üğur Uysal, Enis Özyar, Nazenin Elahi, Mutlu Hayran, Dilek Uzal, Figen B. Demirkazik, Ayşe Kars, Ömer Üğur, Lale Atahan and Coskun F. Bekdik

Departments of Nuclear Medicine, Radiation Oncology, Radiology, Medical Oncology and Cancer Epidemiology, Hacettepe University Medical Center, Ankara, Turkey

We prospectively studied the diagnostic potential of $^{201}$Tl and $^{99m}$Tc-sestamibi (MIBI) SPECT for evaluating the extent of primary disease and differentiating residual/recurrent disease from post-therapy changes in patients with nasopharyngeal carcinoma (NPC). Methods: Fifty patients (20 initial presentation, 30 post-therapy evaluation) underwent $^{201}$Tl and MIBI imaging. The findings were correlated with CT/MRI results. Tumor-to-background ratios were obtained. Biopsy confirmation (14 patients) and/or 6–12 mo clinical follow-up data (16 patients) were available in the post-therapy group. Results: All primary disease sites were accurately detected by both imaging studies in the pretherapy group. However, MIBI-SPECT was superior to $^{201}$Tl SPECT ($p = 0.0057$) in detecting regional metastases (sensitivities of 95% versus 68%). In the posttherapy group, MIBI and $^{201}$Tl imaging were true-positive in 14 of 16 patients with proven residual/recurrent. In 17 patients who had no evidence of residual/recurrent tumor, CT/MRI was false-positive in 13 when MIBI and $^{201}$Tl imaging were true-negative in 10 and false positive in 3. MIBI, $^{201}$Tl and CT/MRI had sensitivities of 87.5%, 87.5%, 100%, specificities of 82.4%, 76.5%, 23.5% and accuracies of 85%, 82%, 61%, respectively. Tumor-to-background ratios were ≤1.5 in all false-positive cases except one. Conclusion: MIBI-SPECT proves more accurate than $^{201}$Tl SPECT in detecting regional metastases at initial presentation. MIBI and $^{201}$Tl imaging have higher specificity and accuracy than CT/MRI and MIBI-SPECT is slightly more specific than $^{201}$Tl SPECT in differentiating residual/recurrent disease from post-therapy changes in patients with NPC.

Key Words: nasopharyngeal carcinoma; thallium-201; technetium-99m-sestamibi; residual disease; SPECT


Despite the low survival rates reported thus far (1). Early diagnosis, treatment and follow-up of NPC are important to improve survival rates. Proper assessment of primary and metastatic NPC requires clinical/fiberoptic examination followed by biopsy when necessary, CT/MRI examination of the nasopharynx and thorax and bone scintigraphy. CT/MRI is the test of choice for accurate locoregional staging at initial presentation. Moreover, subclinical tumor extension to parapharyngeal and retropharyngeal spaces is detected only by these modalities (2–4). After therapy, the clinical situation is complicated by post-therapy changes in the anatomic planes that constitute a diagnostic dilemma in the majority of patients. It is important to avoid false-positive results since they may lead clinicians to perform unnecessary treatment options.

Although imaging technology has improved, a gold standard imaging modality is needed to differentiate viable tumor from post-therapy changes. Postgadolinium-enhanced MRI has been reported to be superior to CT in differentiating necrosis from active tumors, but its false-positive rate for residual/recurrent disease is still unacceptably high (5,6). There is also increasing evidence that PET may allow differentiation between inflammatory changes and viable tumor (7,8). More recently, $^{11}$C-methionine has been used to assess treatment response to radiotherapy in head and neck cancer (9,10). However, its availability and cost are still major limiting factors. There has been growing interest in functional imaging using $^{201}$Tl and MIBI. These agents provide useful tumor imaging information to differentiate physiologic from pathologic uptake in patients with various cancers (11–14). Unfortunately, there is scarce data on scintigraphic evaluation of the extent of primary NPC, its regional or distant metastases, as well as in monitoring the response to treatment and distinguishing residual/recurrent tumor from post-therapy changes (15,16). We thought that clinical application of these tumor imaging agents might further

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For correspondence or reprints contact: Lale Kostakoglu, MD, Hacettepe University Tıp Fakültesi, Nükleer Tıp Anabilim Dalı, Şişliyeye 06100 Ankara, Turkey.