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Radioimmunoscintigraphy in Patients with Early Stage Cutaneous Malignant Melanoma

Michael J. Blend, Hyewon Hyun, Bhupendra Patel, Kathleen Sullivan and Darrell Salk

Section of Nuclear Medicine, University of Illinois Hospital and Medical Center, Chicago, Illinois; Division of Nuclear Medicine, Michael Reese Hospital and Medical Center; and NeoRx Corporation, Seattle, Washington

CT and MRI examinations remain relatively insensitive for the detection of metastatic melanoma lesions, especially those of regional lymph nodes. Imaging cutaneous malignant melanoma patients with the Fab fragment of monoclonal antibody (MAb) NR-ML-05 labeled with ^{99m}Tc has been reported to increase the accuracy of staging. Our purpose in this study was to assess the sensitivity of ^{99m}Tc -labeled NR-ML-05 in detecting the spread of melanoma. **Methods:** Twenty-six adult cutaneous malignant melanoma patients were enrolled in this study and were followed for 6 to 60 mo after radioimmunoscintigraphy. At the time of imaging, 20 patients had their primary lesions resected, whereas the remaining 6 patients had their primary lesions intact. **Results:** Radioimmunoscintigraphy correctly detected 8 of 18 suspicious lesions as malignant, as well as 4 additional malignant lesions which had not been suspected previously. Radioimmunoscintigraphy also correctly identified 8 of the 18 suspicious lesions as benign. Two of the 18 suspicious lesions were found to be false negatives. The overall lesion sensitivity of radioimmunoscintigraphy was 86%. **Conclusion:** Twenty-four of the 26 patients were correctly staged by radioimmunoscintigraphy. The accuracy of staging of cutaneous malignant melanoma patients by clinical and/or radiologic examinations (73%) was greatly improved with the use of radioimmunoscintigraphy (93%). These results suggest that radioimmunoscintigraphy may be a clinically useful adjunct to the current armamentarium for guidance of medical, and particularly surgical, therapy of cutaneous malignant melanoma patients.

Key Words: radioimmunoscintigraphy; monoclonal antibody; staging malignant melanoma

J Nucl Med 1996; 37:252-257

Cutaneous malignant melanoma presently has the most rapidly increasing cancer incidence in whites throughout the world. The age-adjusted incidence has quadrupled during the past 20 yr (1). The major cause of the present epidemic of malignant melanoma is thought to be increasing exposure of susceptible populations to ultraviolet radiation. The five-year survival rate, however, has increased 33% over the past 25 yr, and this improvement is thought to be attributable to earlier diagnosis and better recognition of cutaneous malignant melanoma rather than from refinements in treatment (2,3).

Most primary physicians are now sensitive to the danger presented by pigmented cutaneous lesions that grow and develop satellite lesions over a short period of time. When a suspicious pigmented lesion is removed and a histologic diagnosis of malignant melanoma is confirmed, immediate wide surgical excision is the initial treatment of choice.

The American Joint Committee on Cancer utilizes the TNM (T = tumor, N = nodes, M = metastases) system for staging cutaneous malignant melanoma. In this internationally accepted system, the status of the regional lymph nodes is a critical component of the staging of melanoma. Most patients in the U.S. currently are diagnosed as having Clark's histologic level three (III) with no clinical evidence of metastases (Stage I).

Received Oct. 19, 1994; received Jun. 20, 1995.

For correspondence or reprints contact: Michael J. Blend, PhD, DO, Section of Nuclear Medicine (M/C 931), University of Illinois Hospital, 1740 West Taylor St., Chicago, IL 60612.

Determination of spread to regional lymph nodes or of systemic metastases at the time of initial diagnosis plays an important role in establishing the prognosis and directing the extent and type of therapy in melanoma patients.

The accepted standard of care for local treatment of cutaneous malignant melanoma is the wide excision of the primary lesion. Regional lymphadenectomy is indicated in patients with clinically suspicious lymph nodes or pathologically proven metastases to regional lymph node beds (4-6). The use of prophylactic lymphadenectomy in patients without clinical or radiologic evidence of lymph node disease is controversial. The rationale for prophylactic lymphadenectomy is based on the concept that cutaneous malignant melanoma spreads to lymph nodes initially and then to distant sites. Most patients with clinically palpable nodal disease will already have distant metastases and thus will have a significant reduction in long-term survival. Some studies (7-10) have demonstrated an increased cure rate for patients with intermediate thickness cutaneous malignant melanoma who underwent prophylactic lymphadenectomy. An argument against prophylactic lymph node dissection is that approximately 60%-94% of patients do not have occult metastases and therefore will undergo unnecessary surgery (4,11,12). Several studies have failed to demonstrate any survival difference between patients with and without prophylactic lymphadenectomy (10,13-22).

A simple, noninvasive imaging procedure is needed for accurate determination of the status of regional lymph nodes and for identification of possible distant metastases. Patients with slightly enlarged regional lymph nodes who exhibit no radiologic evidence of nodal or distant disease are problematic for the surgeon when planning the extent of surgical treatment.

A new whole-body imaging technique that can localize tumor sites in multiple organ systems is radioimmunosciintigraphy. This imaging system uses radiolabeled monoclonal antibodies (MAbs) specifically directed against tumor-associated antigens to detect the location and sometimes the volume of tumor tissue present in a patient. Imaging cutaneous malignant melanoma patients with ^{99m}Tc labeled to the Fab fragment of monoclonal antibody NR-ML-05, which recognizes a 250-kd glycoprotein, melanoma-associated antigen, has been reported to provide good accuracy for staging of patients with metastatic disease (23). Our purpose in this study was to assess the sensitivity of radioimmunosciintigraphy with the ^{99m}Tc-labeled MAb NR-ML-05 (Fab fragment) in detecting the spread of disease in early stage cutaneous malignant melanoma patients.

METHODS

Patients

Under a physician-sponsored investigational new drug application with the Food and Drug Administration Center for Biologics Evaluation and Research, this study was conducted at two sites (University of Illinois Hospital, Chicago, IL and Michael Reese Hospital, Chicago, IL) after approval by their respective institutional review boards. Twenty-six adult patients (10 women and 16 men, mean age 47 yr) who had histologically confirmed primary cutaneous malignant melanoma but were otherwise in excellent health were entered into the study.

There were 10, 12 and 4 patients with clinically suspected localized, regional and distant disease, respectively. Of these patients, 20 already had their primary lesion(s) resected at the time of presentation. Table 1 lists the distribution of patients based on their presumed clinical stage and status of their primary lesions at the time of entry into this study. All patients were followed clinically and radiologically for evidence of recurrent disease for

TABLE 1
Number of Patients, Clinical Stage and Status of Primary Lesion at Study Entry

Primary Lesion	STAGE I/II (Localized)	STAGE III (Nodal lesion)	STAGE IV (Distant metastases)
Present	3	2	1
Removed	7	10	3
Total	10	12	4

periods ranging from 6 to 60 mo. The initial results for 12 of these patients have been previously reported (24).

Antibody Preparations

The antibodies used in this study were derived from murine hybridoma cells provided by NeoRx Corp. (Seattle, WA). MAb NR-ML-05 is an immunoglobulin G (IgG_{2b}) that recognizes the 250 kd glycoprotein-proteoglycan melanoma-associated antigen (23). The Fab fragment of NR-ML-05 was radiolabeled with 20 to 30 mCi of ^{99m}Tc immediately before use by a modification of the method described by Fritzberg et al. (25). All reagents were provided by NeoRx Corp. in a cold kit; radiolabeling was performed at the study sites.

Five minutes before the administration of the radiolabeled Fab fragment, 7.5 mg of unlabeled intact NR-ML-05 MAb was administered. Twenty to 30 mCi of the radiolabeled preparation were then given as an intravenous infusion of 5-10 mg of ^{99m}Tc-labeled NR-ML-05 Fab fragment in 30 ml of normal saline.

Eleven of the patients also received 40 mg of an unlabeled nonmelanoma antibody (NR-2AD) intravenously in 20 ml of normal saline over 3 to 5 min, 30 min prior to the radiolabeled anti-melanoma antibody. NR-2AD is a MAb directed against an idiotype of one patient's B-cell lymphoma (23). In earlier studies with an anti-melanoma antibody other than NR-ML-05, preadministration of NR-2AD was needed to reduce nonspecific uptake in nontumor tissue. An equivalency study performed by NeoRx Corp. during the same time period as this study demonstrated that administration of NR-2AD has no effect on the distribution of NR-ML-05 Fab fragment.

Study Protocol

Each patient underwent a complete physical examination and radiologic staging at the time of entry. The preoperative work-up consisted of a baseline CBC, SMAC-24, UA, chest radiograph and CT of the chest, abdomen, pelvis and brain (in selected instances) within 6 wk of the primary operation. Thyroid function tests (T-4, T-3RU, TSH) were also obtained on all patients before radioimmunosciintigraphy and again 6 wk postimaging. On the day of radioimmunosciintigraphy, baseline vital signs were obtained before infusion. All patients were monitored for 1 hr after infusion for signs and symptoms of toxicity. Four to 5 hr postinfusion, patients were asked to drink up to 4 liters of a liquid cathartic (GoLyte) in order to purge the bowel of the excreted radiolabeled MAb.

Six to 9 hr after antibody injection, whole-body anterior and posterior images were obtained with a gamma camera equipped with a high-resolution cast collimator. Left and right lateral views of the head and anterior and posterior views of the chest, abdomen, pelvis and extremities were obtained routinely. SPECT views of regional lymph nodes and areas of known or suspected lesions were also imaged. Patients with suspected tumor involvement in the iliac nodes underwent urinary bladder catheterization for optimal SPECT data acquisition in this region. All patients who were not scheduled for surgery the day following radioimmunosciintigraphy were asked to return for 18 hr planar imaging.

The first image obtained was that of the anterior chest for 1 million counts; all subsequent planar views were obtained for the

same (preset) time. Special planar views of individual lesions, including obliques and laterals, were obtained as needed. Whole-body images were acquired on a 128×512 matrix, whereas spot images were obtained on a 256×256 matrix pattern. Eighteen-hour postinfusion planar images were acquired by collecting 500,000 counts on the anterior chest view, and all subsequent images were obtained for the same (preset) time.

SPECT was used in areas of suspected lesions; a 64×64 matrix acquisition with 64 stops of 40 sec each and a circular orbit was used. Reconstruction parameters included a Butterworth prefilter, center of rotation correction and a ramp filter for backprojection. Postprocessing attenuation correction was applied, and 2-pixel-thick slices were used for format display. All processing algorithms were supplied by General Electric Corp. (Milwaukee, WI). SPECT images were read in all three standard orthogonal views.

Surgical treatment consisted of wide excision of the primary cutaneous melanoma (with or without a split-thickness skin graft). Twelve patients underwent simultaneous regional lymph node dissection without regard for radioimmunoscintigraphy results (24).

Follow-up

All 26 patients were routinely followed by their medical or surgical oncologist for the detection of recurrent disease, on a 3- to 6-mo basis, depending on clinical suspicion. Some patients have been followed for as long as 60 mo. Referring oncologists were asked to obtain a CBC, SMAC-24, UA, chest radiograph and a more extensive radiologic work-up with selected CT scans on a 6-mo basis (or more frequently if needed).

Data Analysis

A previous radioimmunoscintigraphy study with the ^{99m}Tc -labeled Fab fragment of MAb NR-ML-05 had demonstrated that the detection of cutaneous lesions in melanoma patients can be performed more effectively by visual examination than by MAb scan (23). In this study, only nodal and distant metastatic lesions, and not cutaneous lesions, were considered in the data analysis for lesion detection rates.

RESULTS

All patients who participated in the study tolerated the infusion and imaging procedures well and reported no side effects. No allergic or toxic reactions or significant changes in vital signs or blood chemistries were detected.

A typical biodistribution of the radiolabeled antibody ^{99m}Tc -NR-ML-05 Fab in a tumor-free male patient is presented in Figure 1. The normal pattern of biodistribution was not altered significantly in the presence of 40 mg of nonmelanoma MAb NR-2AD. Renal and hepatobiliary routes of excretion, characteristic of Fab fragments, were visualized routinely as localized activity in the kidneys, urinary bladder, gallbladder and intestines. Despite good patient compliance with administration of cathartic, clearance of radioactivity from the gastrointestinal tract was variable at 6 hr postinfusion. The patient image shown in Figure 1 demonstrates more than usual gastrointestinal activity at 6 hr postinfusion. Less variability was noted in the 18-hr postinfusion images. The heart, blood pool and testicular tissues were routinely visualized. There was no significant accumulation of radioactivity to interfere with the detection of metastases in the liver, spleen, bone marrow or other reticuloendothelial organs.

An example of an antibody-positive radioimmunoscintigraphy image is presented in Figure 2. This is an anterior planar image of the pelvis obtained in a 57-yr-old man 6 hr postinfusion of 27 mCi ^{99m}Tc -labeled NR-ML-05 Fab fragment. The patient had a recent history of a cutaneous lesion which was removed from the midposterior aspect of the right lower leg. The findings on CT and physical examination of the pelvis were thought to be normal.

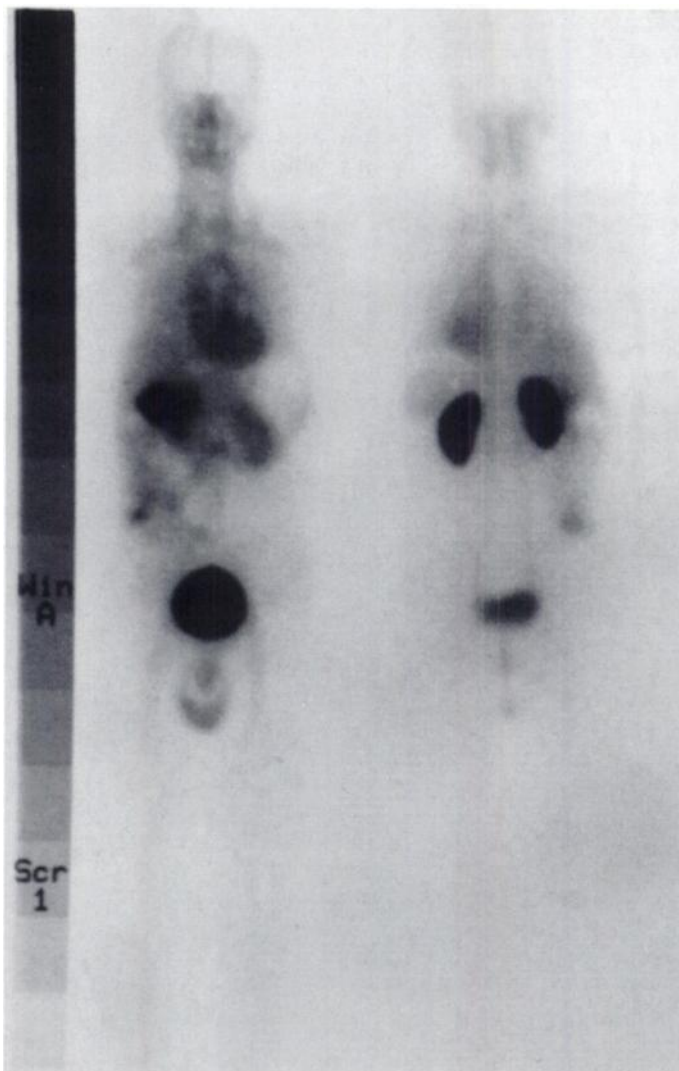


FIGURE 1. Whole-body anterior and posterior radioimmunoscintigraphy images of a normal man shows normal biodistribution in the kidneys, urinary bladder, gallbladder, intestines (routes of excretion), heart, blood pool and testicles.

Resection of the right femoral lymphatic bed, however, was undertaken and a 1.1-cm lesion was confirmed as positive for melanoma by surgical pathology.

Radioimmunodetection of Suspected Lesions

A total of 18 discrete lesions suspected to be melanoma were detected by physical examination or one of the other current diagnostic modalities in 26 of the patients before radioimmunoscintigraphy imaging. The MAb correctly identified eight of these lesions as melanoma and eight as benign. Two of the ten sites that were later found to be melanoma were not identified by radioimmunoscintigraphy imaging (false-negatives). One of these missed lesions was located next to the urinary bladder in a patient who refused catheterization; the other was microscopic disease in an axillary node diagnosed by surgical pathology. Five additional sites of previously unsuspected melanoma were identified by radioimmunoscintigraphy. Four of these were determined to be sites of melanoma by surgical pathology or by follow-up CT and physical examination. Radioimmunoscintigraphy falsely identified one histologically negative lesion in the groin as melanoma (false-positive). Table 2 lists the anatomic distribution of both previously known and previously unsuspected lesions at the time of radioimmunoscintigraphy. The overall lesion sensitivity of radioimmunoscintigraphy was 86% (12/14 true melanoma lesions detected).



FIGURE 2. Anterior planar radioimmunoscintigraphy image of the pelvis in a 57-yr-old man status postexcision of a cutaneous lesion in the right lower leg shows increased uptake (arrow) in a right femoral lymph node. This biopsy-positive lesion was not detected by physical exam or CT.

Patient Management Outcome

Of the 15 patients in this study with true localized disease, only 10 were believed clinically to be Stage I/II (Table 3). Radioimmunoscintigraphy correctly identified 14 of the true Stage I/II patients as confirmed by follow-up CT and clinical examination. One of the 10 patients correctly identified clinically as Stage I/II was upstaged incorrectly by radioimmunoscintigraphy to Stage III.

Of the nine patients with true regional nodal disease (Stage III), eight were correctly diagnosed clinically and eight were correctly staged by radioimmunoscintigraphy, as confirmed by surgical biopsy.

One patient with true Stage III disease was incorrectly staged by radioimmunoscintigraphy as having no nodal disease (Stage I/II). Surgical biopsy showed the presence of axillary micrometastases in this patient, who died 7 mo after the radioimmunoscintigraphy. One patient with true Stage III disease was thought clinically to

TABLE 2

Anatomic Distribution of Lesions Seen in 26 Patients and Corroborated by One or More Current Diagnostic Modalities (CDMs)

	CDM + (Before MAb Study)		CDM + (Immediately after MAb)
	MAb +	MAb -	MAb +
Nodes			
Regional	7	6	3
Distant	0	1	1
Dermis/Subcutaneous	0	0	0
Small Bowel	0	0	0
Liver	1	1	0
Lung	0	1	0
Other	0	1	1
Total	8	10	5
Summary			
True melanoma	8	2	4
True benign	0	8	1

TABLE 3

Accuracy of Clinical and Radioimmunoscintigraphy Staging in Twenty-six Melanoma Patients

True	Clinical stage			Radioimmunoscintigraphy stage		
	I/II	III	IV	I/II	III	IV
I/II (n = 15)	10	3	2	14	1	0
III (n = 9)	0	8	1	1	8	0
IV (n = 2)	0	1	1	0	0	2
Total (n = 26)	10	12	4	15	9	2

have distant metastases (Stage IV). This patient was correctly diagnosed by radioimmunoscintigraphy as having Stage III disease by radioimmunoscintigraphy and is alive 16 mo after antibody imaging.

Both patients with distant metastases were correctly identified by radioimmunoscintigraphy, as confirmed by surgical biopsy results or by clinical and radiologic follow-up. One of these patients was not correctly recognized by initial clinical staging.

Radioimmunoscintigraphy correctly staged 24 of 26 cutaneous malignant melanoma patients (93%), as shown in Table 3 and summarized in Table 4. Two patients were incorrectly staged. One patient was incorrectly staged as having Stage I/II rather than Stage III disease; the other was incorrectly staged as having Stage III rather than Stage I/II disease. Radioimmunoscintigraphy was superior to clinical and radiologic examinations in correctly staging cutaneous malignant melanoma patients. Only 19 of the 26 patients (73%) were correctly staged by clinical and radiologic examinations (Table 4).

The following three cases illustrate clinical situations in which radioimmunoscintigraphy was useful.

Case 1. A 76-yr-old white man had an intact primary melanoma in the interscapular region and palpable (enlarged and suspicious) nodes in the right axilla. Radioimmunoscintigraphy demonstrated activity in both axillae. Increased uptake was also noted in the mediastinal nodes which were not visualized in either chest radiograph or CT of the chest. The findings of radioimmunoscintigraphy were confirmed at surgery, which consisted of wide excision of the primary cutaneous melanoma with split-thickness skin graft and a simultaneous bilateral axillary node dissection. Metastatic melanoma was demonstrated in the lymph nodes harvested from both axillae. The presence of metastatic nodes in the mediastinum was later confirmed by mediastinoscopy. The use of radioimmunoscintigraphy significantly altered the initial clinical staging, which was upgraded from a suspected Stage I/II to Stage III. The patient subsequently died of metastatic melanoma.

Case 2. An 81-yr-old white man had new findings on abdominal CT which were suspicious for recurrent melanoma. The patient had a primary lesion (Clark's level III) removed from his forehead 4 yr prior to the CT finding. Radioimmunoscintigraphy was negative for abdominal tumor. Laparoscopic surgery was positive for retroperitoneal fibrosis. The patient remains disease-free 3 yr postradioimmunoscintigraphy and continues to practice medicine.

Case 3. A third patient, a 67-yr-old white man, was examined 2 mo after removal of a primary lesion from the right buttock.

TABLE 4

Comparison of Accuracy of Clinical versus Radioimmunoscintigraphy Staging

	Clinical staging	Radioimmunoscintigraphy staging
Correct	19/26 (73%)	24/26 (93%)
Incorrect	7/26 (27%)	2/26 (7%)

Radioimmunoscintigraphy was negative, and the patient remained disease-free for 3 mo, when a new subcutaneous nodule located near the primary lesion was detected on physical examination and removed. The patient was disease-free for two additional years, when CT detected lung nodules consistent with distant metastatic spread, for which the patient is presently being treated. This may suggest a need for a radioimmunoscintigraphy system that can be used on multiple occasions.

DISCUSSION

The 5-yr survival rate after surgery for patients with cutaneous malignant melanoma can be less than 20% or greater than 90%, depending on the level of invasion of the primary lesion. These statistics indicate that many occult nodal and systemic metastases are not identified at the time of surgery. Currently, identification of the local extent of a primary cutaneous melanoma and accurate diagnosis of regional nodes or systemic metastases is very difficult with conventional radiologic and laboratory procedures. Although the standard of care for patients with primary cutaneous malignant melanoma is wide excision of the primary tumor with margins of 2–4 cm and lymph node dissection of clinically suspicious nodes, management of the regional node basin without clinically suspicious nodes is controversial.

A sensitive and accurate noninvasive imaging procedure is needed that can detect tumor involvement of regional nodal basin and distant metastases before initial surgery. This would allow identification of patients who may benefit from lymphadenectomy in addition to wide excision of the primary lesion. Such a test would also identify those patients who may not benefit from lymph node dissection. Because melanoma is known to be quite variable in its pattern of spread, an evaluation that includes the whole body, such as ^{67}Ga -citrate or radioimmunoscintigraphy provides a particular advantage over lymphatic mapping or conventional regional radiologic procedures. The ^{67}Ga -citrate whole-body scan, however, has shown a wide range of sensitivities for detection of melanoma lesions (39–82%), which may reflect differences in imaging techniques from one institution to another (27–29).

A less than optimal solution to this problem is the development of an invasive method with the use of isosulfan blue dye-stained lymphatic mapping (2). The initial success rate of localizing sentinel node(s) ranged from 61 to 81% among three surgeons in the study (2). Alex et al. (30,31) recently reported improved success in localizing sulfur colloid labeled $^{99\text{m}}\text{Tc}$ sentinel nodes in cutaneous malignant melanoma patients by means of a gamma-probe-guided technique.

Conventional radiologic procedures such as CT and MRI yield detection rates from 58% to 94% in melanoma patients depending on the stage of the disease (13). Elliott et al. (32) conducted a comparative study of the relative sensitivity and specificity of radioimmunoscintigraphy and CT in the detection of sites of melanoma by using MAbs raised against a high-molecular weight melanoma antigen labeled with ^{111}In . A detailed study of the clinical conditions and detection rates for individual patients with the two methods suggested that both detected approximately 80% of clinically and pathologically confirmed metastases. Radioimmunoscintigraphy, however, was more sensitive than CT in identifying metastases in small or normal-sized nodes in the regional drainage bed of the primary lesion. Radioimmunoscintigraphy was less sensitive than CT in detecting disease in deep organs such as the lung.

With the radioimmunoscintigraphy procedure described in this article, we accurately detected 12 of 23 clinically suspected lesions as malignant and 8 as benign. As expected, the majority

of lesions were found in the regional nodal basin. There were two false-negative lesions and one false-positive lesion. The overall sensitivity of lesion detection was 86%.

A single groin node was missed in a patient who refused catheterization to empty the urinary bladder. Radioimmunoscintigraphy also failed to detect an axillary lesion which was found by the pathologist to be a microscopic focus. The sensitivity of radioimmunoscintigraphy is not expected to extend to micrometastases. One false-positive lesion was detected in the groin region and, in retrospect, most likely was due to misinterpretation of the scan findings.

Despite two cases of misstaging, radioimmunoscintigraphy was found to be superior (93%) to clinical and radiologic examinations (73%) in correctly staging cutaneous malignant melanoma patients, as reflected in Tables 3 and 4.

Given the high sensitivity of radioimmunoscintigraphy for detection of lesions in the regional lymph node basin, repeat radioimmunoscintigraphy examinations in the appropriate patient population may help to define progression of a patient's disease and to offer prompt therapeutic options.

CONCLUSION

Correct recognition of the extent of disease and subsequent accurate staging are essential first steps in the management of patients with cutaneous malignant melanoma. Lesion detection and staging based solely on clinical and or currently available radiologic examinations is not entirely reliable. Based on our previous study (24) and on the data presented in this article, radioimmunoscintigraphy with $^{99\text{m}}\text{Tc}$ NR-ML-05 Fab may be helpful in determining the extent of surgical therapy to be undertaken before the initial wide excision of the primary lesion. The benefit of elective node dissection in patients with clinically nonpalpable nodal disease has not yet been firmly established. The role of lymphadenectomy in patients with enlarged nodes is even more problematic. If radioimmunoscintigraphy with a radiolabeled specific anti-melanoma monoclonal antibody such as $^{99\text{m}}\text{Tc}$ NR-ML-05 can accurately detect disease in the regional lymph node basin and in distant sites, then lymphadenectomy with its attendant morbidity may be reserved only for those patients who have true Stage III disease. Patients without evidence of regional nodal disease or distant metastatic disease could be spared this morbidity. Patients who are presumed to have Stage III disease, but are, in fact, harboring occult distant metastases (Stage IV) could also be spared the morbidity and cost of lymphadenectomy and might benefit from prompt initiation of chemotherapy.

ACKNOWLEDGMENT

Supported in part by the Medical Research Institute Council of Michael Reese Hospital and Medical Center, Chicago, IL.

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Fluorine-18-Fluorodeoxyglucose PET Imaging of Soft-Tissue Sarcoma

Omgo E. Nieweg, Jan Pruijm, Robert J. van Ginkel, Harald J. Hoekstra, Anne M.J. Paans, Willemina M. Molenaar, Heimen Schraffordt Koops and Willem Vaalburg

Division of Surgical Oncology, Department of Surgery, Department of Pathology and National PET Research Center, University Hospital Groningen, Groningen, The Netherlands; and Department of Surgery, The Netherlands Cancer Institute, Amsterdam, The Netherlands

PET with ¹⁸F-fluoro-2-deoxy-D-glucose (FDG) was used to study soft-tissue lesions. The goals of the study were to establish FDG uptake in soft-tissue sarcoma, to determine the sensitivity of this technique, to investigate the correlation between histologic grade and glucose consumption and to determine whether FDG-PET can discriminate between benign and malignant lesions. **Methods:** PET imaging was performed in 18 patients with soft-tissue sarcoma and 4 patients with a benign soft-tissue lesion. Glucose consumption in the tumors was calculated using Patlak's graphical analysis with an assumption made for the lumped constant. Standardized uptake values also were calculated. **Results:** All soft-tissue sarcomas were clearly depicted. The median glucose consumption was 13.0 μ mole/100 g/min (range 2.9-41.8 μ mole/100 g/min). A correlation was found between glucose metabolism and the histopathologic malignancy grade. Such a correlation was not demonstrated for the standardized uptake values. One benign lesion was also visualized. Benign lesions were not visualized in two patients and in the remaining patient an equivocal scan was obtained. Benign lesions could be distinguished from high-grade malignant lesions but not consistently from lesions with low or intermediate malignancy grades. **Conclusion:** PET with FDG is an effective technique to visualize soft-tissue sarcomas. We found a sensitivity of 100%. There is a correlation between glucose metabolic rate and tumor

malignancy grade. FDG appears to be unsuitable for discriminating benign lesions from soft-tissue sarcomas with low or intermediate malignancy grades.

Key Words: soft-tissue sarcomas; neoplasms; tumor grading; PET
J Nucl Med 1996; 37:257-261

Soft-tissue sarcomas are malignant tumors that can arise from mesenchymal structures at any site in the body. These tumors constitute 1% of all cancers. They often reach a large size before a diagnosis is established. Soft-tissue sarcomas are known to invade surrounding normal tissues and disseminate to distant sites, most often to the lungs. The presence or absence of metastases and the tumor malignancy grade will dictate the therapeutic regimen. The fact that ¹⁸F-fluoro-2-deoxy-D-glucose (FDG) is concentrated in various types of tumor tissue (*I*) and the ability of PET to analyze aspects of tumor biology suggest that PET may be of particular value in the therapy of patients with such tumors.

The goals of this study were to establish FDG uptake in soft-tissue sarcoma, to determine sensitivity (percentage of sarcomas that were visualized on the images), to investigate the correlation between histologic grade, regional glucose metabolic rate (RMR_g) and standardized uptake values (SUV), and to determine whether PET with FDG can differentiate between benign and malignant lesions.

Received Dec. 7, 1994; revision accepted Jul. 14, 1995.

For correspondence contact: Omgo E. Nieweg, MD, Department of Surgery, The Netherlands Cancer Institute, Antoni van Leeuwenhoek Huis, Plesmanlaan 121, 1066 CX Amsterdam, The Netherlands.

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