

ORIGINAL ARTICLE

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Radiologic Tests after a New Diagnosis of Breast Cancer

CONTEXT. Radiologic tests may be overused in the staging of newly diagnosed breast cancer.

OBJECTIVE. To determine the frequency with which radiologic tests are used in women with newly diagnosed breast cancer and the yield of such tests in these patients.

METHODS. We used the tumor registry database from the Hoag Cancer Center, Newport Beach, California, to identify and classify the disease stage of all patients with breast cancer who received a diagnosis from or were initially treated by Hoag staff from 1990 to 1994. After excluding patients with unknown tumor (T) and lymph node (N) status, we retrospectively determined the frequency with which radiologic tests were performed within 4 weeks of diagnosis and the proportion of these tests that detected metastatic disease.

RESULTS. A total of 1910 radiologic tests, including 646 bone scans, 637 chest radiographs, and 627 other tests, were obtained in 1167 patients with a known TN status. Radiologic tests were performed in 42% of patients with carcinoma in situ, but none of the 183 tests detected metastases. Eight hundred twenty-eight radiologic tests were performed in patients who were classified as having stage I disease on the basis of TN criteria. Only three of these tests (0.4%) detected metastatic disease, and all three were performed in one patient with bone pain. For patients who were classified as having stage IIA, stage IIB, or stage III disease on the basis of TN criteria, 5 of 410 tests (1.2%), 20 of 294 tests (6.8%), and 33 of 195 tests (17%), respectively, yielded positive results.

CONCLUSIONS. Radiologic staging tests are overused in patients with newly diagnosed, early-stage breast cancer. These tests are unnecessary in patients with breast cancer who have 1) a tumor that is 5 cm in diameter or smaller, 2) no axillary lymphadenopathy on physical examination, 3) normal results on blood chemistry tests, and 4) no symptoms or physical findings of metastatic disease.

Screening mammography, breast self-examination, and physician examination have resulted in more frequent detection of early-stage breast cancer.¹ A total of 1531 patients were added to the tumor registry of the Hoag Cancer Center, Newport Beach, California, between 1981 and 1992. During the intervals 1981 to 1984, 1985 to 1988, and 1989 to 1992, the incidence of localized invasive cancer increased from 53% to 55% to 56%, regional spread of disease decreased from 33% to 26% to 22%, and findings of distant metastatic disease at diagnosis decreased from 8% to 6% to 4%.²

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For many years, it has been known that smaller lesions are less likely than larger lesions to be associated with overt metastatic disease.³ However, most practicing physicians have been taught that “good medical practice” includes routine ordering of radiologic tests for any patient with a new diagnosis of cancer. Furthermore, it is widely believed that metastatic disease can be detected at diagnosis in many asymptomatic patients because of the improved sensitivity of bone scans, abdominal ultrasonography, computed tomography, and magnetic resonance imaging. However, these tests cannot detect micrometastatic disease or reliably detect lesions that are 1 cm in diameter or smaller.⁴

The practice of routinely ordering radiologic tests in asymptomatic patients with newly diagnosed breast cancer has repeatedly been challenged because few tests yield positive results.⁵⁻⁷ Despite this and the fact that most women with newly diagnosed breast cancer have localized or in situ disease, we believed that many community physicians still routinely used radiologic tests as part of the initial staging process. We performed a retrospective analysis to assess the frequency with which radiologic tests are used in patients with a new diagnosis of breast cancer and to determine the yield of such tests in these patients.

Methods

Patients

We selected the study sample from 1224 women who were included in the tumor registry of the Hoag Cancer Center and had received a diagnosis of breast cancer between 1990 and 1994. All patients received their initial diagnosis from or were first managed by physicians on the medical staff of Hoag Memorial Hospital Presbyterian, a 417-bed community hospital in Newport Beach, California. More than 100 physicians, including family practitioners, internists, gynecologists, general surgeons, radiation oncologists, and medical oncologists, were involved in the management of these patients. Data sources included hospital medical records related to admissions and procedures, pathology reports, radiology reports, radiation oncology records, medical oncology records, and direct responses to inquiries made by tumor registrars to managing physicians. Physicians on the Cancer Committee at Hoag Memorial Hospital Presbyterian reviewed approximately 10% of all cases to confirm the accuracy of the tumor registry’s data collection.

We determined disease stage by using the tumor, node, metastasis (TNM) classification system, which was developed by the American Joint Committee on Cancer.⁸ We excluded 57 patients because data were insufficient to allow us to classify their disease according to this system; therefore, our analysis included 1167 patients.

Classification of TN Stage

To determine the ways in which the yield of radiologic tests varied by the extent of disease, we classified each patient’s disease by using clinical information—size of tumors and degree of axillary lymph node involvement—that was probably available when the decision to test was made. Therefore, we used only the T and N criteria of the TNM classification system to determine the stage of disease (subsequently referred to as *TN stage*). The relations between stage 0 through stage IIIB and TN status are shown in **Table 1**.

Frequency of Testing and Detection of Distant Metastases

We determined the number and type of radiologic tests performed during the first course of treatment or within 4 months after the date of diagnosis, whichever occurred first. Most radiologic tests were obtained after an initial biopsy but before definitive surgery; some tests were obtained shortly after surgery. Radiology reports, biopsy reports, and managing physicians’ interpretation of these reports, as stated in medical records, were used to define a test as “positive” or “negative” for metastatic cancer.

In clinical practice, it is almost impossible to verify by biopsy all sites that are suggestive of cancer on radio-

TABLE 1
Definition of TN Stage for Breast Cancer*

STAGE	TUMOR CLASSIFICATION	NODE CLASSIFICATION
0	Tis	N0
I	T1	N0
IIA	Tis–T1 T2	N1 N0
IIB	T2 T3	N1 N0
IIIA	Tis–T2 T3	N2 N1–N2
IIIB	T4 Any T	Any N N3

*N0 = no regional lymph node metastases; N1 = metastases to movable ipsilateral axillary nodes; N2 = metastases to ipsilateral axillary nodes that are matted together or fixed; N3 = metastases to ipsilateral internal mammary nodes; Tis = carcinoma in situ; T1 = tumor < 2 cm in greatest dimension; T2 = tumor 2 to 5 cm in greatest dimension; T3 = tumor > 5 cm in greatest dimension; T4 = tumor of any size with direct extension to chest wall or skin.

logic tests. Computed tomography of the chest was considered positive for metastatic disease only if lesions were detected in the lung parenchyma, mediastinum, pleura, or bone. Disease in the breast, chest wall, or axilla was not considered to represent distant metastases. In accordance with tumor registry guidelines, we used all diagnostic and therapeutic information obtained during the first course of treatment or within 4 months after the date of diagnosis, whichever occurred first, to determine the presence or absence of metastatic disease. Many equivocal or false-positive lesions were interpreted as negative for the purposes of final staging on the basis of these guidelines.

We used CNET/CancerNet statistical software (C/NET Solutions, Berkeley, California) to generate descriptive statistics on the types of tests performed in patients with various stages of disease. The percentages of positive and negative test results were calculated by using simple proportions with 95% CIs.

Results

Frequency of Testing

We obtained the results of 1910 radiologic tests—including 646 bone scans, 637 chest radiographs, and 627 other tests—in 1167 patients. Table 2 shows the frequency with which various radiologic tests were performed according to TN disease stage.

Detection of Metastases

Table 3 shows the proportion of these 1910 radiologic tests that detected metastatic cancer in patients by TN stage.

None of the 183 radiologic tests performed in patients with carcinoma in situ detected metastases. Eight hundred twenty-eight radiologic tests were performed in patients with TN stage I disease. Only 3 of these tests (0.4%) detected metastatic disease and all 3 were performed in 1 patient with bone pain. For patients who were classified as having stage IIA, IIB, and III disease on the basis of TN criteria, 5 of 410 tests (1.2%), 20 of 294 tests (6.8%), and 33 of 195 tests (17%), respectively, yielded positive results. Figure 1 shows the percentage and 95% CIs of all radiologic tests that detected distant metastases for each TN stage.

Silent Metastases

In patients who had no symptoms or signs of distant metastases, radiologic tests rarely identified metastatic disease. “Silent” metastases to lung or bone were detected radiographically in only 5 of 32 patients with metastatic disease: 2 patients with TN stage IIA disease, 2 patients with TN stage IIB disease, and 1 patient with TN stage III disease (Table 3). No silent metastases were detected in patients with carcinoma in situ or TN stage I disease.

Most researchers believe that breast cancer is more biologically aggressive in younger women and that younger women are more likely to have detectable metastatic disease at diagnosis.⁹ We divided the sample into 10-year age groups and examined the frequency with which radiologic tests detected metastatic disease in these groups. In all age groups, 2% to 6% of radiologic tests detected distant metastases, with overlapping 95% CIs.

TABLE 2
Proportion of Breast Cancer Patients Tested by TN Stage*

RADIOLOGIC TEST	STAGE 0 (n = 220)	STAGE I (n = 502)	STAGE IIA (n = 241)	STAGE IIB (n = 126)	STAGE III (n = 78)
Bone scan	20%	60%	62%	75%	69%
Chest radiography	42%	57%	51%	66%	65%
Abdominal ultrasonography	8%	23%	22%	36%	19%
Abdominal CT	5%	9%	15%	17%	28%
Chest CT	6%	7%	8%	11%	26%
Pelvic CT	1%	6%	9%	13%	26%
Liver scan	0.5%	2%	4%	10%	3%
Brain CT or MRI	0.5%	0%	6%	4%	14%
Any radiologic test (95% CI)	53% (47%–60%)	77% (73%–81%)	78% (73%–84%)	84% (78%–90%)	88% (81%–96%)

*CT = computed tomography; MRI = magnetic resonance imaging.

TABLE 3

Yield of Radiologic Tests for Metastatic Cancer by TN Stage*

RADIOLOGIC TEST	STAGE 0 (n = 220)	STAGE I (n = 502)	STAGE IIA (n = 241)	STAGE IIB (n = 126)	STAGE III (n = 78)
Bone scan, n/n	0/45	1/302	2/150	6/95	11/54
Chest radiography, n/n	0/92	0/288	1/123	5/83	6/51
Abdominal ultrasonography, n/n	0/17	0/114	0/52	0/45	1/15
Abdominal CT, n/n	0/10	1/43	1/36	4/22	4/22
Chest CT, n/n	0/14	0/37	1/19	3/14	7/20
Pelvic CT, n/n	0/3	1/32	0/21	2/17	2/20
Liver scan, n/n	0/1	0/12	0/4	0/12	0/2
Brain CT or MRI, n/n	0/1	0/0	0/5	0/6	2/11
Positive test results, n/n (95% CI)	0/183 (0%) [0–2.4]	3/828 (0.4%) [0–1.1]	5/410 (1.2%) [0–2.2]	20/294 (6.8%) [3.9–9.7]	33/195 (17%) [12–22]
Patients with silent metastases, n	0	0	2 [†]	2 [†]	1 [‡]
Total patients with metastases, n	0	1 [§]	4	9	12

*CT = computed tomography; MRI = magnetic resonance imaging.

[†]In each case, one patient had silent pulmonary metastases detected by chest radiography; the other patient had silent bone metastases detected by bone scan.

[‡]Patient had stage IIB disease; silent bone metastases were detected by bone scan.

[§]Patient presented with bone pain.

Discussion

Our study showed that although many radiologic tests are performed in patients with early-stage breast cancer, “silent” metastases are rarely detected. Radiologic tests detected metastatic disease in only 5 patients who did not have locally advanced breast cancer, symptoms, or signs (including physical findings) that suggested distant metastatic cancer. These 5 patients represented only 0.4% of the 1167 patients for whom T and N staging was assigned in our study. Only 3 radiologic tests yielded positive results in patients with TN stage I breast cancer, and all 3 of these tests were done in 1 patient who presented with symptoms of bone pain that led first to the finding of metastatic disease and then to the finding of primary breast cancer. Only 5 radiologic tests yielded positive results in 3 patients with TN stage IIA disease who were found to have distant metastases. Radiologic tests detected no distant metastases in women who were surgically classified as having stage T1–T3 N0 disease after pathologic examination of ipsilateral axillary lymph nodes. Positive test results were especially uncommon in patients who had TN stage 0, I, or IIA disease (which accounted for 83% of all patients and 74% of radiologic tests analyzed in this study).

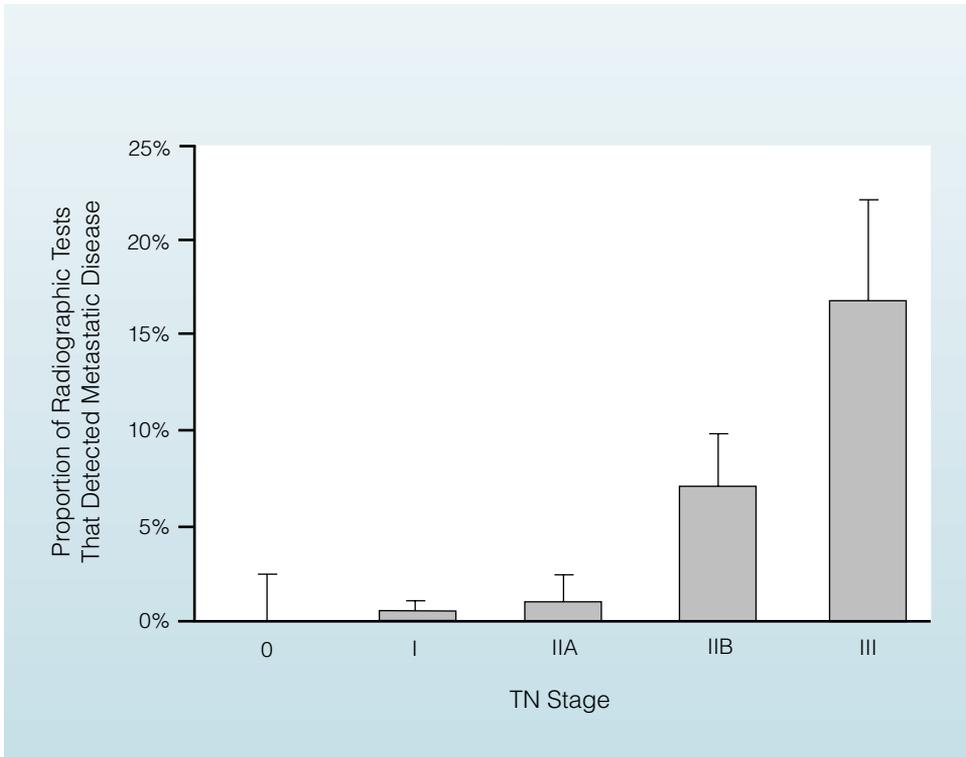
Technetium-99 radionuclide bone scans were performed in 55% of patients and were the most frequently ordered tests. Many studies have found that bone scans

are not justified in patients with TN stage I and II breast cancer who have no symptoms or signs of metastatic bone disease.^{5–7, 10–13} Forty-five bone scans that yielded negative results were performed in patients who did not have invasive breast cancer. Some physicians may order this test as a baseline for future comparisons, but the value of that strategy has not been established.

In smaller series, bone scans have detected metastatic disease in only 0.3% to 1.8% of patients with early-stage disease but no bone pain.^{10–13} In our study, 9 bone scans yielded positive results in 547 patients (1.6%) with stage I or stage II disease. Most of these 9 patients had symptoms or signs of bone metastases. Three hundred two bone scans were done in patients with TN stage I disease; only 1 of these scans (0.3%) yielded positive results (in a patient who presented with a pathologic bone fracture). Eight of 245 bone scans (3.3%) yielded positive results in patients with TN stage II disease, but only 2 of these scans detected “silent” metastases.

Results of chest radiography were reported for 55% of patients. The National Cancer Center Network (NCCN) guidelines recommend chest radiography as an initial staging test in patients with TN stage I breast cancer despite the lack of objective data to justify its use.¹⁴ In our study, chest radiography detected metastatic cancer in 0 of 92 patients with TN stage 0 disease, 0 of 288 patients with TN stage I disease, and 1 of 123 patients with TN stage IIA disease. No evidence supports the

FIGURE 1. Radiographic tests that detected metastatic disease, by TN stage. Error bars represent the upper limits of the 95% CIs.



use of chest radiography in asymptomatic patients with TN stage I or IIA disease. However, our results support the NCCN statement that other radiologic tests are unnecessary in patients who have no symptoms or signs of metastases.

Abdominal ultrasonography, the most frequently ordered radiologic test for abdominal metastases, yielded negative results in 228 patients who had TN stage 0, I, or IIA disease. Ultrasonography yielded positive results in 1 woman with TN stage IIB disease who had symptoms and signs of liver metastases.

Abdominal computed tomography is probably more sensitive than ultrasonography for detecting abdominal metastases, but only 2 of 89 tests yielded positive results in 2 patients who were thought to have TN stage 0, I, or IIA disease. One of these 2 patients presented with right upper-quadrant pain and the other presented with bone pain and was found to have bone lesions. Therefore, computed tomography failed to detect any “silent” metastases in these 89 patients. Seven patients with TN stage IIB disease and elevated liver enzymes levels had abdominal computed tomography that detected liver metastases. Abdominal computed tomography confirmed but did not originally detect bone metastases in 2 patients who had elevated alkaline phosphatase levels and abnormal results on bone scan. Therefore, in the absence of abnormal results on liver enzyme tests, abdominal computed tomography is not useful in detecting liver metastases or other intra-

abdominal sites of metastatic disease in patients with TN stage 0, I, or IIA disease.

In our retrospective analysis, it was not always possible to determine the number of tests that were performed because patients presented with specific symptoms. Therefore, the incidence of positive test results in asymptomatic women may be lower than our study suggests. In addition, we were unable to ascertain the proportion of tests that yielded false-positive results.

In summary, we found that most radiologic tests ordered in patients with early-stage breast cancer did not detect metastatic disease and were not a necessary part of disease staging. Studies that have appeared since our report was originally submitted for publication have confirmed the dubious value of such tests.^{15,16} Physicians may have many reasons for ordering radiologic tests; however, they should not order them to try to detect distant metastatic disease or to avoid unnecessary surgery. Furthermore, it is unlikely that metastatic disease will be detected immediately after surgery in a woman whose disease has been surgically staged as N0. Our findings suggest that physicians should surgically stage the axilla without radiologic tests if a patient with breast cancer has 1) a primary tumor less than 5 cm in diameter, 2) clinically negative axillary nodes, and 3) no symptoms or signs of metastatic disease. If the axilla is surgically negative, further staging is not necessary. Radiologic staging seemed to have no value in patients with TN stage I disease; it was useful only in patients

with TN stage II disease who had many positive axillary nodes at surgery. If physicians had not ordered radiologic tests in patients with early-stage disease (those with TN stage 0, I, IIA, or IIB disease and no symptoms or signs of metastasis), as many as 1700 tests—approximately 89%—could have been eliminated.

Take-Home Points

- Because breast cancer screening is emphasized in the United States, most patients with newly diagnosed disease have noninvasive cancer or small, localized breast tumors.
- Radiologic testing for metastatic disease is unnecessary in patients who have ductal or lobular carcinoma in situ.
- In the absence of locally or regionally advanced disease and symptoms or signs of metastatic cancer, radiologic testing rarely detects “silent” distant metastases.
- Physicians should surgically stage the axilla without ordering radiologic staging tests if a patient with breast cancer has 1) a primary tumor that is less than 5 cm in diameter, 2) clinically negative axillary nodes, and 3) no symptoms or signs of metastatic disease.

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Presentation

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