
ATYPICALLY LOCATED SINGLE HOT SPOT IN BONE SCINTIGRAPHY: HOW OFTEN IS IT A METASTASIS?

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ABSTRACT

OBJECTIVES: 1) To identify the frequency of bone metastases which appears as atypically located single hot spot on bone scan in patients with extraosseous malignancy but without current evidence of metastatic bone diseases. 2) To identify the common sites of metastasis with such findings.

MATERIALS AND METHODS: All bone scans of the patients with extraosseous malignancy but without current evidence of metastatic bone diseases performed at Ramathibodi Hospital during January 1996 to December 1997 were selected. A nuclear medicine physician blindly reviewed the selected scans and only the scans with atypically located single hot spot were included for clarification of their causes. The verification procedure includes histology, CT, MRI, progression of bone scan lesions, or a clinical follow-up of at least 2 years.

RESULTS: During the specified period, there were 100 patients (62 women, 38 men; age range 25-81 years; mean age 57.96 years) with atypically located single hot spot without known skeletal metastasis. Bone metastasis was confirmed in 8 patients (8%); 4 with breast cancer, 2 with cervical carcinoma, and 2 with head and neck cancer. Such findings were classified as benign lesions in 64 patients and as indeterminate in 28 patients. The frequency of a hot spot being a metastatic focus is 2 of 7 (28.57%) at the sternum, 1 of 28 (3.57%) at the ribs, 1 of 4 (25%) at the costovertebral junction, and 4 of 41 (9.76%) at the lower lumbar spine. None of such findings were proved to be malignant at the cervical spine, the scapula, the manubrium, the sacrum and the sacroiliac joint.

CONCLUSION: The frequency of bone metastasis which appears as atypically located single hot spot on bone scan in patients with extraosseous malignancy but without current evidence of metastatic bone disease was 8%. The most common site of such findings is the sternum, particularly in patients with breast cancer.

BACKGROUND AND RATIONALE

The high sensitivity of bone scan in determining the presence and the extent of metastatic disease makes it an extremely important tool in decision making, particularly since survival rates

in patients with multiple distant osseous metastases from many tumors is worse than in those with isolated osseous disease.

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Finding metastases is frequently important to clinical decisions affecting quality of life. Serial bone scanning in patients with known metastases is valuable in therapeutic decision making, particularly if it is used in combination with other clinical information.

Approximately 80 percent of patients with known neoplasms and bone pain will have metastases documented by bone scan. The fact that 30-50 percent of patients with metastases do not have bone pain, a good case may be made for scanning such as asymptomatic patients with tumor that have a propensity to metastasize to bone (e.g., breast, lung, and prostate). However, for tumors with low rate of osseous metastases (e.g., cervix, head, and neck), the procedure is not cost-effective.¹

Most metastases are multiple and relatively obvious. When a single lesion is identified, the false positive rate for attributing the finding to metastases is high. Overall, 43% of solitary lesions are malignant but this figure masks considerable variation according to the anatomical site of the lesion. Thus solitary spinal and skull hot spots are said to be malignant in up to 80% of cases, while solitary hot spots in ribs are said to be malignant in 10-17% of cases.²⁻⁴

OBJECTIVES

1. To identify the etiology of atypically located single hot spot on bone scan in patients who attended Ramathibodi hospital with extraosseous malignancy but without current evidence of metastatic bone disease.

2. To assess if malignancy of such findings differ among :

- 2.1 different tumor types
- 2.2 different location of the skeletal lesion

MATERIALS AND METHODS

Consecutive bone scans performed at Ramathibodi Hospital from January 1996 to December 1997 were reviewed by a nuclear medicine physician and those fulfilled all of the following criteria were included.

Inclusion criteria

1. Extraosseous malignancy
2. No pre-existing evidence of bone metastasis
3. Single hot spots in the skeleton not typical for bone metastasis such as a tiny round rib lesion

Exclusion criteria

The hot spots at the sites uncommon to have degenerative disease and, hence higher probability to be metastatic disease are excluded as follows:

- skull
- thoracic and L1-2 vertebrae
- appendicular skeleton
- pelvic bone, except for SI joints

Bone scintigraphy was performed 2 hours following an intravenous administration of 15 mCi of technetium-99m methylene diphosphonate (^{99m}Tc- MDP). Total body scinti-scans were obtained on each patient.

The lesion was classed as malignant based on one of the following criteria:³

1. Demonstration of bone destruction at the site of the hot spot by plain radiography, computed tomography scanning, or magnetic resonance imaging, either contemporaneously or on follow-up.
2. Progression of the abnormality with the development of other areas of increased uptake on subsequent bone scan.

The lesion was classed as benign based on one of the following criteria³:

1. No clinical manifestation suggesting bone metastasis after at least 2 years of follow up.
2. Normal radiographic appearances without evidence of metastatic disease after at least 2 years

of follow up.

3. Simple fracture demonstrated at plain radiography with healing evidence on subsequent radiographs.

4. Characteristic appearances of benign tumor on plain radiography or conditions with no change over at least 12 months of follow-up.

5. Post surgical changes demonstrated at the site of increased uptake.

Those with findings not falling into either benign or malignant criteria were categorized as indeterminate.

RESEARCH DESIGN

A descriptive study (Retrospective data collection)

RESULTS

There were 100 patients who fulfilled the selected criteria (62 women, 38 men; age range 25 - 81 years; mean age 57.96 years). The primary tumoral site was breast cancer in 47 patients (47%); carcinoma of the head and neck in 27 patients (27%); lung cancer in 8 patients (8%); cervical carcinoma in 5 patients (5%); esophageal cancer in 2 patients (2%); and uterine carcinoma in 1 patients (1%). The rest of the patients, 10 (10%), had other primary tumors including periampullary carcinoma, colonic carcinoma, rectal carcinoma, renal pelvis carcinoma, urinary bladder carcinoma, carcinoma of the prostate gland, and NHL (Table 1).

Table 1. Nature of Skeletal Hot Spots Correlated with Primary Tumor Site

| Primary Tumor | Malignant* | Benign* | Indeterminate* | Total** |
|---------------|------------|--------------|----------------|------------|
| Breast | 4 (8.5%) | 40 (85.11%) | 3 (6.38%) | 47 (47%) |
| Head and neck | 2 (7.41%) | 12 (44.44%) | 13 (48.15%) | 27 (27%) |
| Lung | 0 (0%) | 4 (50%) | 4 (50%) | 8 (8%) |
| Cervix | 2 (40%) | 2 (40%) | 1 (20%) | 5 (5%) |
| Corpus | 0 (0%) | 1 (100%) | 0 (0%) | 1 (1%) |
| Esophagus | 0 (0%) | 0 (0%) | 2 (100%) | 2 (2%) |
| Others | 0 (0%) | 5 (50%) | 5 (50%) | 10 (10%) |
| Total | 8 (8%) | 64 (64%) | 28 (28%) | 100 (100%) |

* Numbers in parentheses are percentages according to the primary tumor site subgroup.

** Numbers in parentheses are percentages according to 100 patients.

There were 64 patients (64%) negative for the diagnosis of bone metastasis. Twenty-eight patients were classified as indeterminate (28%), most were loss to follow up before 2 years. In the remaining 8 patients (8%), bone metastases were confirmed. This group included 4 of 47 patients

with breast cancer (8.5%), 2 of 5 patients with cervical carcinoma (40%), and 2 of 27 patients with head and neck cancer (7.41%), each of which had carcinoma of pyriform sinus and the other had nasopharyngeal carcinoma.

Table 2. Nature of Skeletal Hot Spots Correlated with Locations

| Hot spot location | Malignant* | Benign* | Indeterminate* | Total** |
|--------------------------------|------------|-------------|----------------|------------|
| Sternum | 2 (28.57%) | 3 (42.86%) | 2 (28.57%) | 7 (7%) |
| Rib | 1 (3.57%) | 20 (71.43%) | 7 (25%) | 28 (28%) |
| Costovertebral junction | 1 (25%) | 1 (25%) | 2 (50%) | 4 (4%) |
| Lower lumbar | 4 (9.76%) | 23 (56.1%) | 14 (34.14%) | 41 (41%) |
| Others*** | 0 (0%) | 17 (85%) | 3 (15%) | 20 (20%) |
| Total | 8 (8%) | 64 (64%) | 28 (28%) | 100 (100%) |

* Numbers in parentheses are percentage according to hot spot location subgroup.

** Numbers in parentheses are percentage according to all 100 patients.

***Including cervical spine, scapula, costochondral junction, manubriosternal junction, sternoclavicular joint, manubrium, sacrum, and sacroiliac joint

About the location (Table 2), no hot spots detected at the cervical spine, scapula, costochondral junction, sternoclavicular joint, manubriosternal junction, manubrium, sacrum, and sacroiliac joint were malignant. Two out of seven patients (28.57%) with a hot spot on the sternum, 1 out of 28 patients (3.57%) with a hot spot on the rib, 1 out of 4 patients (25%) with a hot spot on the costovertebral junction, and 4 of 41 patients (9.76%) with a hot spot on the lower lumbar spine did have bone metastases.

Of all 8 skeletal metastases, 4 were located

at the lower lumbar vertebra, 2 at the sternum, and each of the rest at the rib and costovertebral junction. In patients with primary breast cancer, 2 (50%) skeletal metastases were located at the lower lumbar spine (from 16 cases) and the other two (50%) at the sternum (from 6 cases, Figure 1). In 2 patients with carcinoma of the cervix, one skeletal metastasis was located at the rib and the other at the lower lumbar region (Figure 2). In 2 patients with head and neck cancer, one metastasis which was seen at the lower lumbar spine and the other at costovertebral junction.

Table 3. Incidence of Positive Bone Scan in Different Malignancy Correlated with the Location

| Sites Diseases | Sternum | Rib | Costovertebral junction | Lower lumbar | Total |
|-------------------|---------|-----------|-------------------------|--------------|----------|
| Breast | 2 (50%) | 0 | 0 | 2 (50%) | 4 (50%) |
| Cervix | 0 | 1 (50%) | 0 | 1 (50%) | 2 (25%) |
| H & N | 0 | 0 | 1 (50 %) | 1 (50%) | 2 (25%) |
| Total | 2 (25%) | 1 (12.5%) | 1 (12.5%) | 4 (50%) | 8 (100%) |



Fig.1 Breast cancer with sternal metastasis



Fig. 2 cervical cancer with lower lumbar metastasis

DISCUSSION

Bone scintigraphy is a highly sensitive technique for detecting bone metastases in the absence of trauma, inflammation, or degenerative changes. Multiple lesions, especially in the vertebral column and skull, are strongly suggestive of the metastatic disease, whereas other solitary lesion poses the diagnostic problems in the patients with known malignancies. Any single or double hot spot in a patient with a history of malignant tumor indicates the need for further investigations, such as conventional radiography, CT, MRI, or biopsy, and will impose physical strain and distress on the patient and cause additional costs. Positive osseous tumor spread was 8 cases (8%) which was slightly lower than those in other reports (10-17%). It could be partly due to the fact that the collectable patients did not represent all known malignant patients with atypical solitary hot spot on bone scan during the studying period. Another reason was that the known malignant patients sent for bone scannings did not represent

all known malignant patients in Ramathibodi hospital. Systemic treatment, chemotherapy, was probably to be a cause of no progression of the bone scans' findings that cause false negative in the results.

In this study, the primary breast cancer was the most common cause of osseous metastasis (4 cases, 50%) similar to the results of the study by Puig and coworkers⁵ (4 in 15 cases, 26.67%). These findings may be explained by its propensity to spread to bone and by its relatively high incidence. Two of five cases (40%) with the cervical cancer were malignant lesion. This was probably because the patients with cervical cancer were sent for a bone scan only when they had advanced disease. One patient was in stage IIIB, presented with unimproved epigastrical pain, and a rib lesion was detected on bone scan. The other was in stage IVB (inguinal nodal metastasis), presented with low back pain and suspected

degenerative changes at the lower lumbar spines on bone scan, but metastasis was confirmed on CT. There were 2 cases (7.41%) of skeletal spreading from head and neck cancer. One, of which known case of carcinoma of the pyriform sinus T4N2CM0, had progression of the findings on the follow up bone scan (6 months interval) without any symptom. The other, known case of nasopharyngeal carcinoma T2N0M0, also had progression of the positive findings on bone scan.

The primary tumor failed to signify for the prediction of malignancy in atypically located hot spots. Two cases (50%) of the patients with breast cancer were located at the sternum (2 in 6 of sternal lesions, 33.33%). Although isolated sternal abnormalities are uncommon in patients with breast cancer, a high percentage of these lesions are due to a malignant etiology. Andrew and coworkers⁶ showed 26 malignant lesions from all 34 solitary sternal abnormalities (76%). So the known breast cancer with sternal lesion should be further investigated.

None of the hot spots on the sternoclavicular joint, was caused by metastases. This finding agreed with the study by Puig and coworkers⁵ in that hot spots in the sternoclavicular joint never indicated malignancy. The hot spots at the cervical spine, scapula, manubriosternal junction, manubrium, costochondral junction, and sacroiliac joint were not resulted from metastases in the study which was slightly different from Puig and coworkers' study, where metastases were located at transverse process of cervical vertebra, manubriosternal junction, and costal cartilage.

A single hot spot at the lower lumbar spine was frequently due to benign process, such as DJD. However, about 9.8% (4/41) were due to skeletal metastasis.

CONCLUSION

This study was limited in several ways;

small population studied that were not representing all known malignant patients, unprompted data, or loss to follow up of the patients themselves. However, a single atypical hot spot in the skeleton in patients with extraosseous malignancy without evidence of metastatic bone disease should raise a high suspicion of metastases, especially in the appropriate clinical circumstance, and could be confirmed by further appropriate radiographic studies or invasive procedures to exclude incipient metastatic disease. Whether or not skeletal metastasis of such findings differs among different malignancy could not be established due to limited number of positive cases. Nevertheless it did pointed out that a sternal lesion in patients with carcinoma of the breast had a high probability of being malignant, and that a lower lumbar hot spot should not be regarded as benign.

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