

A Study of Cases with Rib Metastasis Difficult to Distinguish from Microfractures on Bone Scintigraphy

Nobuaki OTSUKA, Masao FUKUNAGA, Koichi MORITA,
Shimato ONO, Kiyohisa NAGAI, Tatsushi TOMOMITSU,
Shinichi YANAGIMOTO, Hiroaki MIMURA,
Hiroshi SONOO*, Junichi HIRATSUKA**,
Yoshinari IMAJO** and Hiroyoshi TANAKA***

*Department of Nuclear Medicine, *Department of Endocrine Surgery,
Department of Radiology, *Department of Urology,
Kawasaki Medical School, Kurashiki 701-01, Japan
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ABSTRACT. A retrospective study of about 10,000 cases at Kawasaki Medical School Hospital on whom bone scans were performed over a six year period revealed five cases in which metastasis was mistaken for a benign rib lesion. This mistake occurred because the accumulation pattern of the radionuclide in the rib region on the bone scan indicated a so-called "hot spot" observed with microfractures rather than the rod-like increased accumulation along costal bones that is coincident with the finding of bone metastasis. This experience suggests that solitary hot spots in the rib region on bone scans should be diagnosed carefully, as such an accumulation is most frequently associated with a benign etiology but rarely may be a malignant lesion.

Key words: rib metastasis — microfracture — bone scintigraphy

The possibility of bone metastasis exists in almost all patients with malignant tumors. Therefore, early diagnosis of bone metastasis plays an important role the choice of therapy, early introduction of therapy, monitoring of the patient's course after treatment, and evaluation of the therapeutic effect on bone metastasis.

Bone scintigraphy using ^{99m}Tc -labeled phosphorous compound can detect bone lesions at an early stage of metastasis.¹⁻³⁾ However, ^{99m}Tc -phosphorous compounds do not specifically accumulate in tumor cells, and they also deposit at sites of active bone formation,⁴⁾ such as in areas of fracture repair. Therefore, it is often very difficult to distinguish these lesions from bone metastasis. We have experienced five cases in which bone metastasis was mistaken for a benign lesion due to the fact that accumulation pattern of the radionuclide in rib region on bone scintigraphy indicated a so-called "hot spot" seen with microfractures rather than the rod-like increased accumulation along costal bones coincident with the finding of bone metastasis.

MATERIALS AND METHODS

Bone scintigraphy was performed in about 10,000 cases during the period of seven years from June 1985 to June 1992. In five of these cases, bone lesions were diagnosed as benign in spite of malignancy. These five cases included three cases with prostatic cancer, one case with breast cancer, and one case with lung cancer. Whole skeletal bone scintigraphy was performed three hours after intravenous administration of 740 MBq ^{99m}Tc -hydroxymethylene diphosphonate (HMDP). Spot images in the rib(s) were also taken on anterior, posterior and oblique views. In certain kinds of tumors such as the bone lesions of multiple myeloma or bone metastasis from thyroid cancer in which bone resorption occurs unaccompanied by bone formation, filling defects are noticed on bone scintigraphy. Therefore, such cases were excluded from this study.

CASE REPORT

Case 1: The patient was a 58-year-old woman with breast cancer (Fig. 1) who had undergone an extended mastectomy for breast cancer two years earlier, and she was checked for bone metastasis by bone scintigraphy every six months. On November 18, 1985, bone scintigraphy revealed a slight hot spot in the right lower rib. Although this hot spot showed increased accumulation on scintigraphy six months later, it was still diagnosed as a microfracture. Furthermore, a follow-up study after another six months showed abnormal accumulation along lower rib. Metastases to the whole skeleton were confirmed one year later.

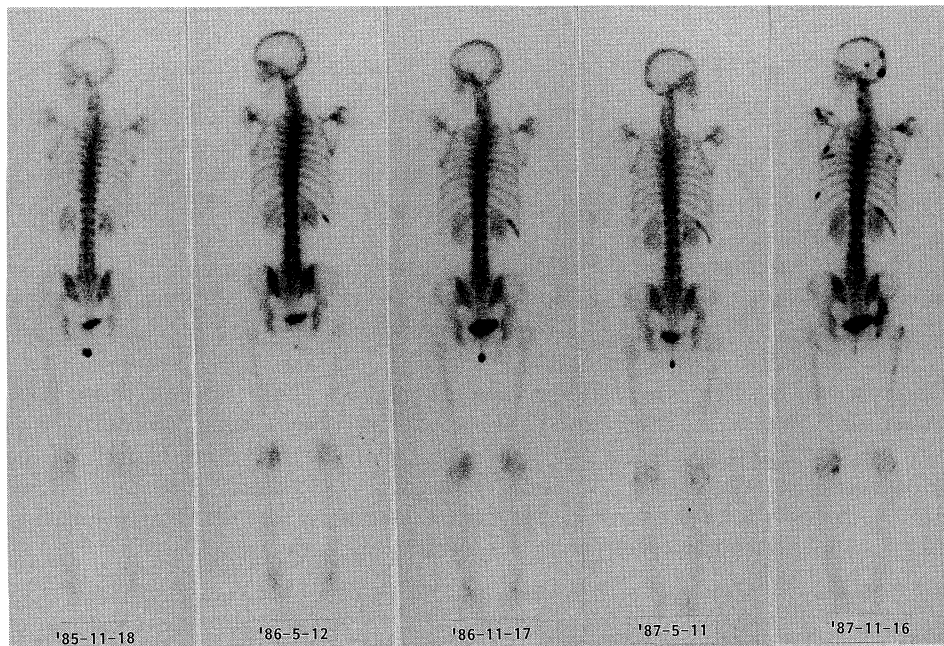


Fig. 1. Bone scintigraphy showed a small hot spot in the left XI rib, the activity of which increased every six months.

Case 2: The patient was a 51-year-old male with lung cancer (Fig. 2) who had undergone chemotherapy and radiotherapy for lung cancer. Thereafter, bone scintigraphy was performed. A small hot spot was found in the upper left rib on bone scintigraphy, but no specific subjective symptom was recognized. Bone scintigraphy performed within the following three months revealed decreased activity, and it was diagnosed as a microfracture of the rib. Thereafter, the course was followed up for an additional six months. After six months, the radionuclide activity on bone scintigraphy increased, and bone metastasis was confirmed.

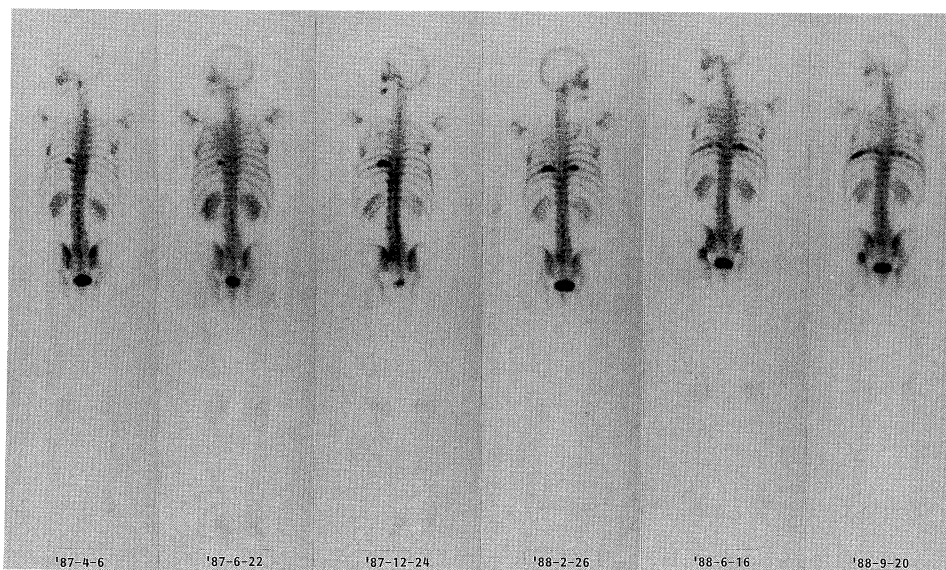


Fig. 2. Bone scintigraphy showed a hot spot in the left VIII rib, the activity of which decreased two months after initial scintigraphy. However, increased activity was again noted in the same region three months later. Six months after second scintigraphy, bone scintigraphy showed a rod-like increased accumulation along the costal bone.

Case 3: The patient was a 65-year-old male with prostatic cancer (Fig. 3) who had undergone surgery for this cancer at an another hospital. He was admitted to the Department of Radiology of our hospital for radiotherapy of the affected region. On bone scintigraphy in April 1991, a small hot spot was noted in the upper right rib, but neither subjective symptoms nor abnormal findings on bone roentgenography were recognized. The patient was followed up with bone scintigraphy until three months after surgery, but no specific change was observed. In March 1992, however, an enhanced rod-like accumulation indicative of bone metastasis was noted in the right rib, and multiple bone metastases were confirmed six months later.

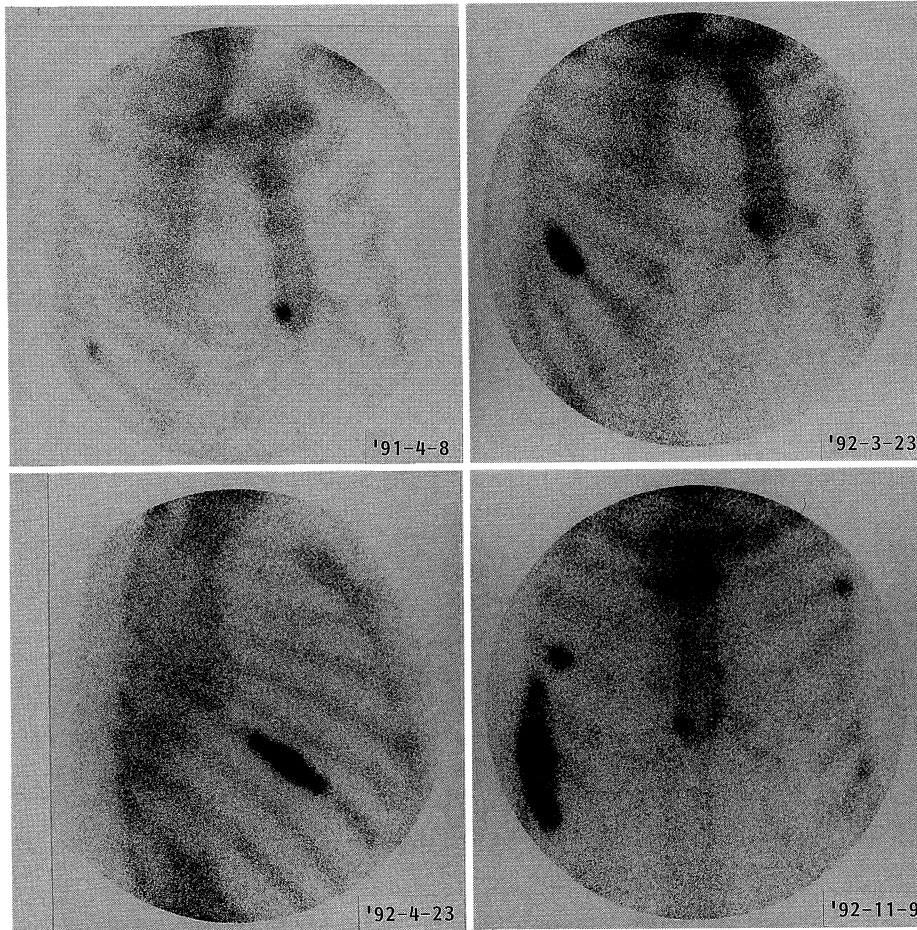


Fig. 3. Right anterior oblique bone scintigraphy showed a small hot spot in the anterior portion of the right VII rib. It disclosed a rod-like increased accumulation along the costal bone about one year later.

Case 4: The patient was a 76-year-old male with prostatic cancer (Fig. 4a, 4b) who admitted to the Department of Urology of our hospital because of this cancer. Bone scintigraphy was performed to check bone metastasis. A small hot spot was found in the right twelfth rib. The diagnosis of bone metastasis was difficult because overlapped with an image of the kidney, in which radionuclide had accumulated. An X-ray tomographic image of the region showed mild osteosclerosis. After the rib metastasis was diagnosed, chemotherapy and an orchiectomy were carried out, and the abnormal accumulation disappeared.

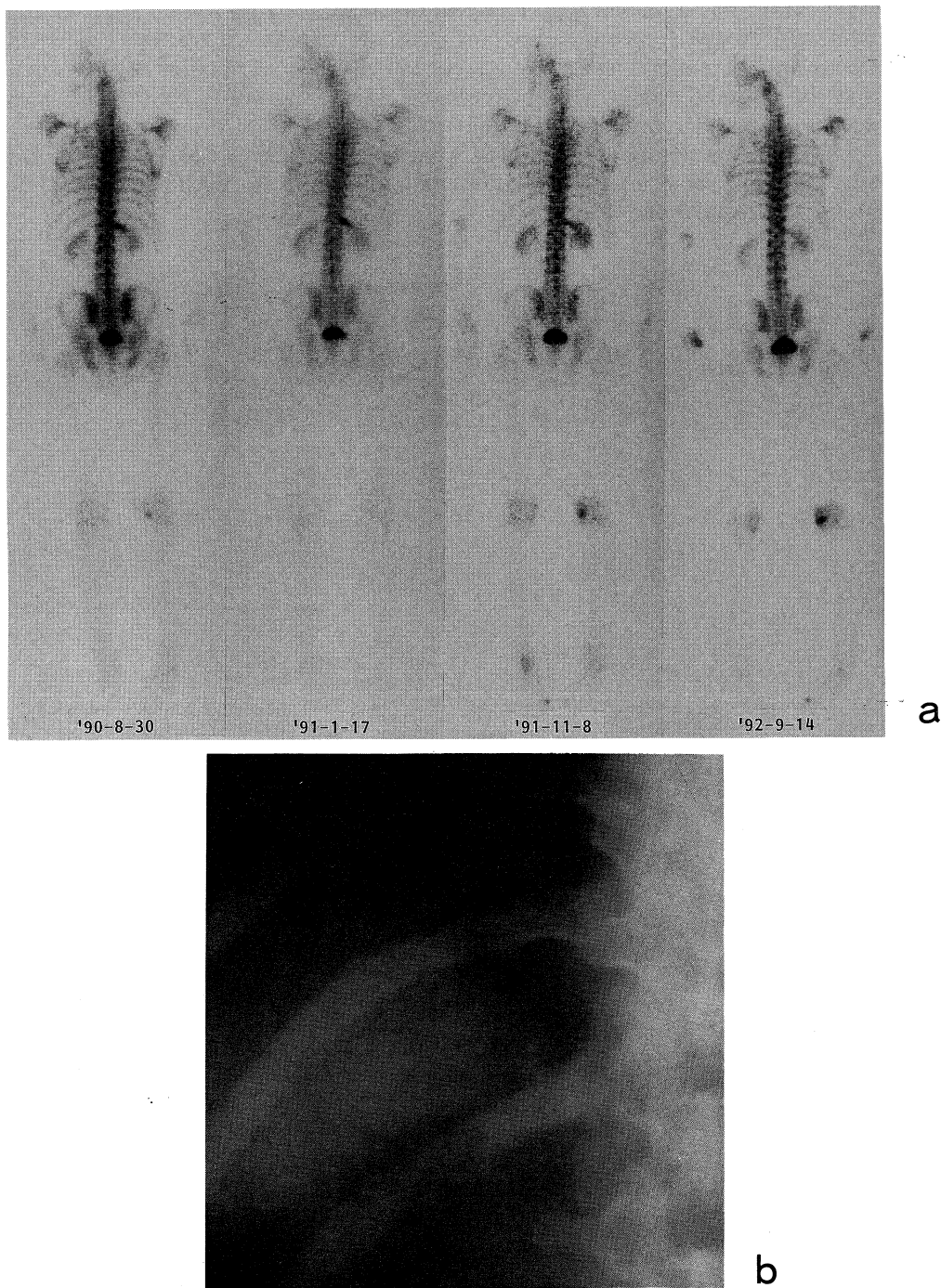


Fig. 4a, 4b. Bone scintigraphy disclosed increased activity in the right XIII rib which was overlapped by accumulation of radionuclide in the kidney (a). A bone radiogram (tomogram) of the rib detected a sclerotic change in the right XIII rib (b). After chemotherapy for prostatic cancer, bone scintigraphy showed complete resolution two years after initial scintigraphy (a).

Case 5: The patient was a 73-year-old male with prostatic cancer (Fig. 5) who had received chemotherapy for prostatic cancer. Five years after this treatment, the patient was diagnosed as having local recurrence of this cancer, and bone scintigraphy was performed. This showed a faintly increased accumulation of radioactivity in the left XI rib.

Follow-up scintigraphy showed gradually increasing activity at the same site, and one year later, bone scintigraphy showed a rod-like accumulation along the costal bone.

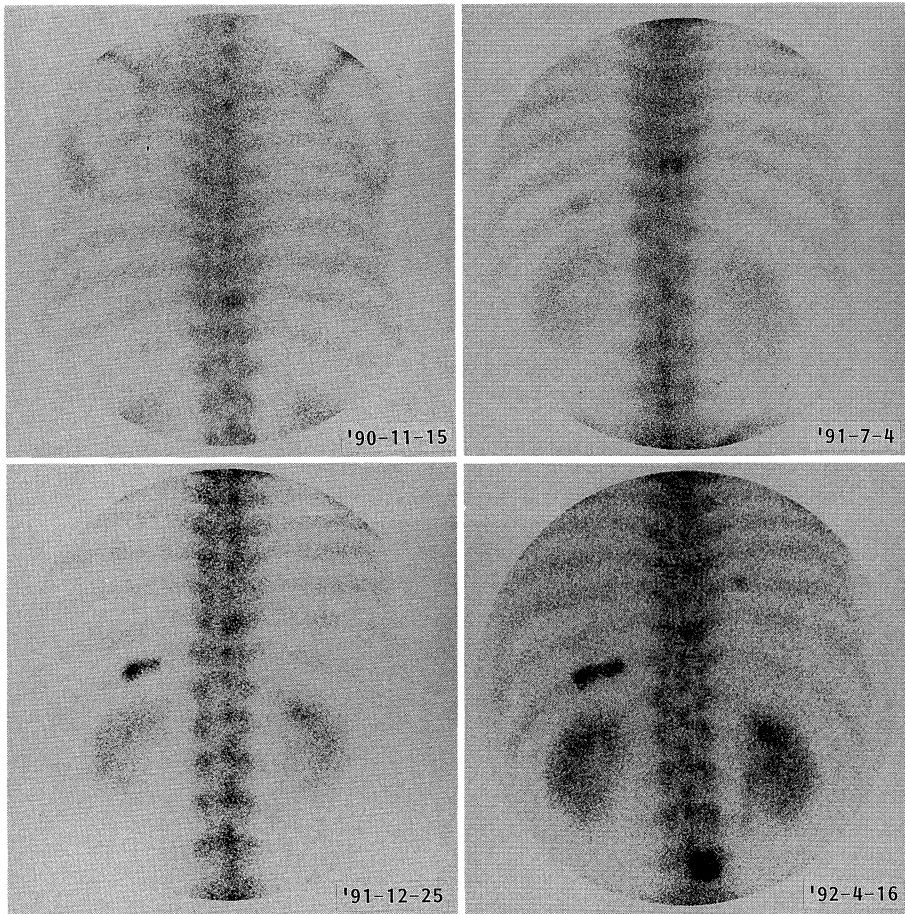


Fig. 5. Bone scintigraphy disclosed faintly increased activity in the left XI rib. It showed diffuse involvement along the line of the left XI rib one year later.

DISCUSSION

Bone scintigraphy using ^{99m}Tc -phosphorous compounds is capable of revealing bone lesions at an early stage of metastasis, while a 30% to 50% change in the mineral content of bone is necessary before it is possible to

detect a bone lesion on X-ray film.⁵⁾ ^{99m}Tc-phosphorous compounds, however, do not specifically accumulate in tumor cells. Therefore, a positive bone scan in a cancer patient does not necessarily indicate bone metastasis. For this reason, it is essential to differentiate bone metastasis from other benign diseases on bone scintigrams. Abnormalities seen on bone scintigrams are frequently the result of senile changes, and it is often difficult to distinguish these benign abnormalities from metastasis. Microfractures in the ribs associated with osteoporosis are usually visualized as small hot spots in the costochondral junction or the lower ribs. A compression fracture in the vertebral bone demonstrates enhanced linear accumulation. In spondylosis deformans, a hot spot is seen in osteophytes or the vertebral body.

In such cases, it necessary to evaluate not only the findings on bone scintigraphy but also those from bone roentgenography. If senile change is demonstrated on the radiographic image, it is much easier to interpret the results of scintigraphy.

However, more difficulty exists in the interpretation of radiographic images in the costochondral region or the lower rib, because of the existence of costochondral calcification and osteoporotic changes with aging. As on X-ray CT, the ribs, which form the curved thoracic cage, are imaged in a linear cross-sectional manner. This is not precise enough for evaluation.

In cases where multiple abnormal accumulations are observed in the bone regions on bone scintigraphy or a rod-like abnormal accumulation is noted along the ribs, bone metastasis can be easily diagnosed.⁶⁾ If there is a history of injury to the chest, or if there are spotty or aligned accumulations on the lateral or posterior aspects of the thoracic cage, a diagnosis of microfracture can be made.⁷⁾ In many cases, however, when a single hot spot is found in costal region in a patient with a malignant tumor on bone scintigraphy, it is very difficult to decide whether it is bone metastasis or not. The reported incidence of metastasis in single rib lesions varies from 2% to 17% in patients with extraosseous malignancy. The remainder are due to benign etiologies.⁸⁾ In such cases, a follow-up study with bone scintigraphy may provide useful information for differentiation between benign disease and malignant tumor, and the early diagnosis of bone metastasis.

We have decided the interval for observation based on grades classified from the results of bone scintigraphy. A single slight accumulation, such as that observed in our present cases, is classified as Grade B, and should be reexamined after three months. However, in four of the five present cases, early diagnosis by follow-up bone scintigraphy was difficult. This might be attributed to the fact that hot spots are rarely seen in the early stage of bone metastasis, and the bone metastasis abruptly advanced during a short period.

To avoid such false negative results, bone biopsy with bone imaging in the costal region should be performed.⁹⁾ A small hot spot in the rib on the bone scintigraphy of a patient with breast cancer may not be bone metastasis because rib microfractures are associated with the radiation therapy for this type of cancer.⁸⁾ On the other hand, in the case of lung cancer, careful observation of a hot spot is necessary, because a high incidence of rib metastasis is known.⁶⁾ Bone metastasis can occur at any site in the case of a malignant tumor. In particular, microfractures due to osteoporotic change are likely to occur in the rib(s) in elderly patients with cancer. In conclusion, our experience with the

cases in the present study suggests that hot spots in the rib region should be diagnosed carefully, as such an accumulation is most frequently associated with a benign etiology, but rarely may be a malignant lesion.

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