
Clinical Significance of Solitary Rib Lesions in Patients with Extraskkeletal Malignancy

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A retrospective review of 2,851 bone scans done at a cancer center over a period of 4 yr revealed 41 patients having a single abnormality in a rib as their first abnormal scintigraphic finding. The scan findings in these cases were correlated with clinical, scintigraphic, and radiographic follow-up to ascertain their etiology and course. Four lesions (9.8%) were due to malignant disease, 16 (39%) were associated with benign fractures demonstrated on x-ray, 11 (27%) were associated with primary or postoperative radiation therapy. The remaining ten patients (24.2%) with normal x-rays and no association with radiation therapy or subsequent development of metastasis were assigned to benign etiology. This experience suggests that solitary rib lesions in cancer patients are uncommon and are most frequently (90%) associated with benign etiology.

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Solitary lesions, not uncommonly encountered during skeletal scintigraphy, are most often seen in the spine and pelvis, followed by the ribs, extremities, and skull (1,2). Although the incidence of a metastatic etiology for these solitary lesions approximates 50% (2), the potential for malignancy varies according to the anatomic site of involvement (1). For instance, solitary neoplastic foci in a rib are reported to occur in 2% of the general hospital population (3) and 17% of patients with extraosseous primary tumors (1). We undertook a retrospective analysis of bone scan results to assess the incidence and clinical relevance of solitary rib lesions as defined on bone scan in patients with cancer.

MATERIALS AND METHODS

Of the 2,851 bone scans done at our institution between June 1977 and June 1981, 41 patients were identified as having a single abnormality in a rib as their first abnormal scintigraphic finding (Table 1). Scans were performed 3-4 hr following i.v. administration of 15-20 mCi (555-740 MBq) of technetium-99m methy-

lene diphosphonate ($[^{99m}\text{Tc}]$ MDP). Total-body scintiscans were obtained on each patient, utilizing a 37 photomultiplier tube large field-of-view gamma camera, fitted with a low-energy, all-purpose collimator and a moving bed (24 cm/min). Additional static, 500,000, count views were obtained of those areas considered either scintigraphically or clinically suspicious.

Lesion intensity was graded as follows: +1 = subtle, +2 = clearly defined; +3 = or > adjacent rib activity; +4 = equal to urinary bladder activity. Lesions were also designated (a) focal (if they were ovoid and discrete), or (b) diffuse (if they extended linearly along the length of the rib).

The scans and medical records of the 41 patients were reviewed and the intensity and pattern of uptake were correlated with other scintigraphic, radiographic, and clinical information.

RESULTS

The distribution of rib lesions by pathologic diagnosis is outlined in Table 1. No correlation was found between pattern or intensity of abnormal uptake in these lesions and the etiology (Table 2).

Four lesions were due to malignant disease, two of

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TABLE 1
Distribution of Rib Lesions by Pathologic Diagnosis

Primary tumor	No. patients	Etiology			
		Benign Fx*	RT†	Unknown	Malignant
Breast	33	10	11	9	3
Lung	6	4	0	1	1
Pheo‡	1	1	0	0	0
Carcinoid§	1	1	0	0	0
Total	41	16	11	10	4

* Fx = Fracture.
† RT = Radiation therapy.
‡ Pheochromocytoma.
§ Intestinal carcinoid.

TABLE 2
Etiology, Location, and Pattern of Solitary Rib Lesions on Bone Scan

Scan pattern	Etiology											
	Fracture			RT			Malignant			Unknown		
	A†	Ax‡	P§	A	Ax	P	A	Ax	P	A	Ax	P
Focal	3	5	6	8	2	0	1	1	0	5	2	0
Diffuse	0	0	2	1	0	0	1	0	1	0	0	3

* RT = Radiation therapy.
† A = Anterior.
‡ Ax = Axillary.
§ P = Posterior.

these secondary to direct invasion by primary lung and recurrent breast tumors, respectively, and two hematogenously metastatic based on (a) response to hormonal therapy (4), and (b) subsequent development of other metastatic skeletal foci (Fig. 1).

Sixteen were due to nonpathologic fractures documented by plain radiographs. Ten additional cases, with normal plain radiographs, were assigned benign etiologies based upon clinical follow-up, eight subsequently showed normal bone scans and were without disease 16–65 months (mo) later (\bar{X} = 35m) and two showed no change and were without disease on follow-up bone scans at 27 and 31 mo.

Eleven lesions were associated with primary or post-operative radiation therapy. All foci appeared on a first scan, obtained between 2 and 26 mo following radiation. Ten of the 11 foci were located in the second rib anteriorly; the remaining focus was seen in the anterolateral sixth rib, all on the side of radiation exposure. While eight lesions returned to normal over 3–44 mo (\bar{X} = 17.8m), two remained unchanged for 17 and 32 mo and demonstrated no evidence of malignant conversion. Five of the 11 foci correlated with benign healing fractures on radiographs (Fig. 2).

DISCUSSION

Bone scintigraphy is widely accepted as the screening test of choice for defining skeletal metastases. This is based upon the fact that the test is extremely sensitive

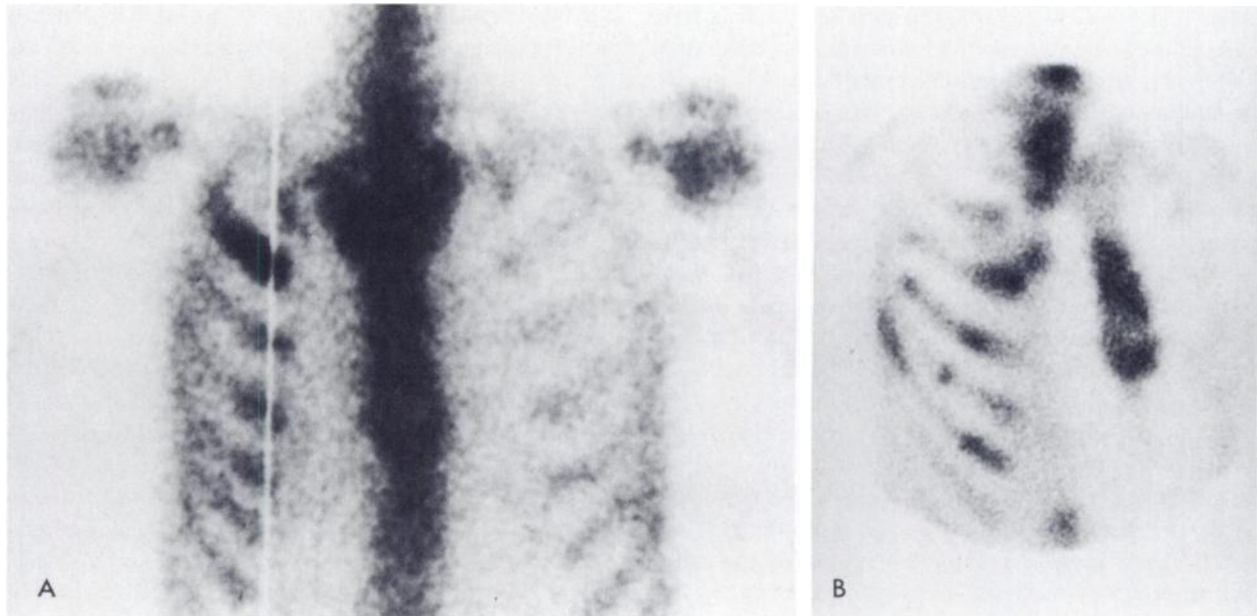


FIGURE 1
A: Anterior bone scan view of thorax shows segmental area of increased radioactivity in anterior portion of second right rib.
B: Right anterior oblique bone scan view of same patient 3 mo later shows other foci of increased uptake in skeleton due to metastases

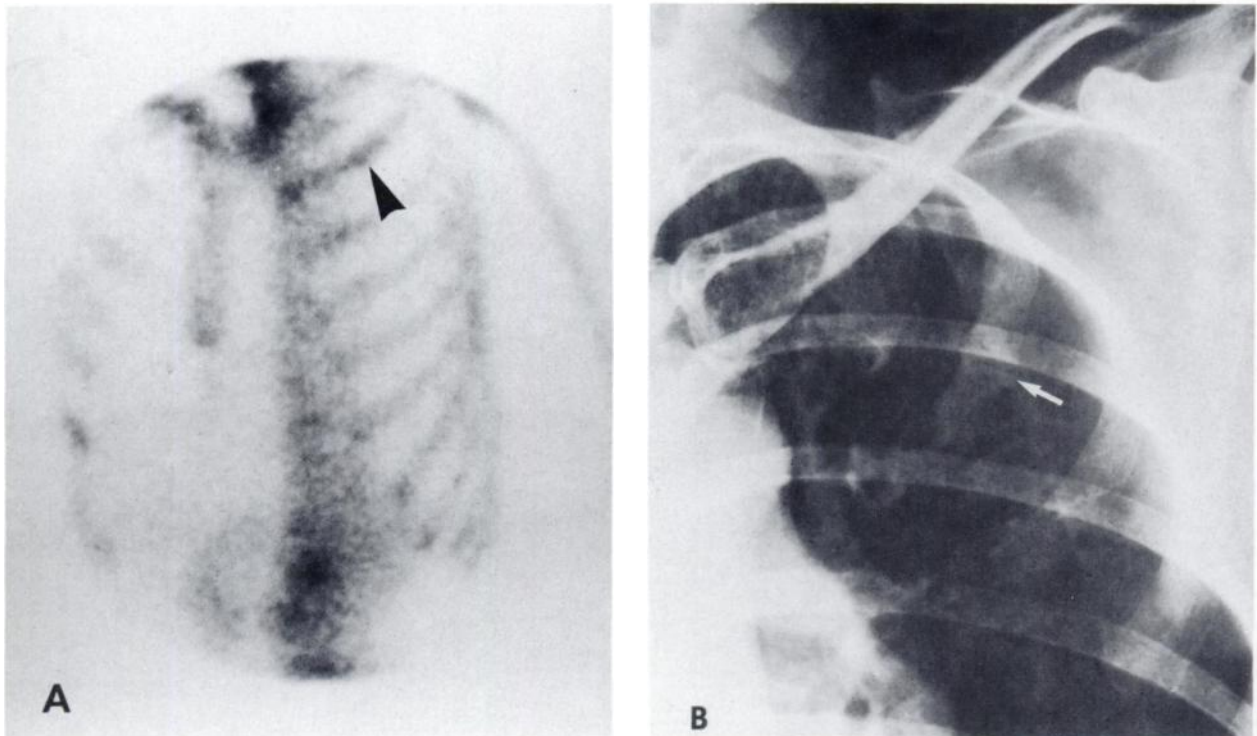


FIGURE 2

A: Left anterior oblique bone scan view of chest of patient imaged 6 mo following radiation therapy for left breast carcinoma. Segmental area of increased uptake is demonstrated (arrow head). **B:** Radiograph of left upper ribs demonstrates simple fracture in same rib (arrow)

for identifying alterations in bone metabolism. However, the test carries a low specificity. This can become a clinical problem when a *solitary* focus of abnormal uptake is noted (1). Although previous reports have suggested that the regional distribution of lesions should not be used to determine probability of benignity or malignancy, a number of cases in varied anatomical areas, particularly the ribs, were noted to be secondary to a benign etiology (1). The incidence of metastases in single rib lesions varies from 2% in the general hospital patient (3) to 17% in patients with extraosseous malignancy (1). We found metastases in 9.8% (4/41) of our patients; the remainder were due to benign etiologies.

Two interesting subgroups of patients were noted in our study. The first group included 11 patients who had received primary (six patients) or postoperative (five patients) radiation therapy for breast cancer and manifested isolated foci of abnormal radionuclide uptake in ribs included within the radiation field. The method of primary radiation therapy has been documented elsewhere (6). All patients received 4,500–4,600 rad external beam treatment to the breast using linear accelerators (4–8 mV). Three fields were utilized, one en-face (anterior-posterior) to the supraclavicular and axillary nodal areas, and two opposing tangential beams to the breast. Three patients were boosted by iridium interstitial implants and two with electron beam therapy. Rib

fracture is a recognized delayed complication of chest wall and primary breast radiation therapy, however the incidence is low, reported to approximate 5–7% (5).

In our experience, rib fractures associated with use of tangential beam therapy in the treatment of breast cancer developed in the second rib anteriorly. This location corresponds to the junction of the en-face portal, directed to the supraclavicular and axillary nodal regions and the medial and lateral tangential fields to the breast.

Beam divergence along this matchline can result in a minute overlap of all three fields at a site, corresponding to the second rib. Additionally, an area of potential beam inhomogeneity occurs along the posterior portion of the medial and lateral tangential fields (6). This is due to variation in either chest wall thickness or breast contour as related to the medial and lateral fields. As a result, there is an increase in radiation dose to tissues closest to the beam; generally, those along the posterior border of the tangential fields. These tissues (and underlying rib) receive a 5–10% greater dose than that calculated throughout the volume to be treated (6).

The second subgroup included ten patients with scan findings described as indeterminate (1) due to a lack of clinical or radiologic confirmation as to their etiology. Since none of these patients developed metastases over a mean interval of 35 mo (range of 16–65 mo) and eight

have converted to normal follow-up bone scans, we must assume that the bone scan findings were due to a benign etiology.

In our experience, solitary rib lesions in the cancer patient are uncommon (1.4%); when seen, they are most frequently associated with a benign etiology (90.2%), either trauma or previous exposure to radiation therapy. Since only 9.8% of lesions were malignant (half of which were hematogenously disseminated), we would suggest that if the etiology of such a lesion cannot be documented by radiography or biopsy, the patient should be given the benefit of the doubt and the lesion attributed to a benign cause particularly when further therapy is predicated on the presence of a normal bone scan.

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