Bone Scanning in Ewing's Sarcoma

N. Nair

Radiation Medicine Centre, Bhabha Atomic Research Centre, Bombay, India

This is a retrospective analysis of bone scans in 72 patients with Ewing's sarcoma. Sites of primary disease were found to be evenly distributed among the axial skeleton and the proximal and distal extremities. Primary disease sites in the axial skeleton were more frequently associated with metastases. Fifty-three of these patients had their first scans done at presentation; among them, 25 were found to have metastases. Unsuspected metastases were picked up in 28 of all the patients. Metastases at presentation were seen to be associated with a poorer prognosis.


Ewing's sarcoma, a malignant tumor of bone that may also arise in soft tissue had been associated with poor 5-yr survival rates when only the primary was treated (1-4). Megavoltage radiotherapy was reported to show superior 5-yr survival rates; however, many of the patients were also treated with adjuvant chemotherapy (5). Clinically evident metastases at time of diagnosis were traditionally considered ominous (6) and these patients had a uniformly poor course (7). Combination of chemotherapy, radiation therapy, and surgery have been reported to produce improved disease-free survival rates (8,12).

As absence of skeletal metastases on clinical or radiological examination does not necessarily mean that metastases are absent, and since detection of metastatic lesions by scintigraphy often antedates their detection by radiography, bone scanning has a unique place in patient evaluation. It has been included in pretreatment investigations along with x-ray of primary sites, chest x-rays, and occasionally bipedal lymphangiograms (6,8).

This paper is an analysis of the findings of bone scans performed in 72 patients with Ewing's sarcoma.

MATERIALS AND METHODS

Scans of 72 patients with histologically proved Ewing's sarcoma, who were referred to us for bone scanning from a local cancer hospital between 1979 and 1983, were analyzed. Scintigraphic follow-up between 6 mo and 2 yr was obtained in ten patients.

All patients had radiation therapy as part of their primary therapy; 40 received chemotherapy with different combinations of vincristine, doxorubicin hydrochloride, actinomycin D, and cyclophosphamide. Scans were performed 3 hr after i.v. injection of 20 mCi of technetium-99m-(99mTc) labeled hydroxyethylidene or methylene diphosphonate, on a Picker Dyna 4/15 gamma camera with a multiformat imaging system. Anterior and posterior views were obtained and since the entire skeleton could not be imaged at once, imaging was done in parts.

Areas of abnormal concentration on the bone scans were grouped into those of the axial skeleton, (skull, sternum, spine, clavicle, ribs, scapula, and pelvis), the proximal extremity (humerus and femur) and the distal extremity (hand, foot, ankle, wrist, radius, ulna, tibia, and fibula).

The site of involvement with which the patient first presented was designated as primary and any other site that appeared subsequently or was detected on scan was considered metastatic.

RESULTS

Of the 72 patients, 47 were male and 25 female. Age range was 1 to 60 yr. The majority (76.3%) were in their twenties and thirties. Thirty-five were children age 15 yr or less. Fifty-three patients had scans done within 6 mo of presentation and were considered at presentation.

The most common site of primary disease was the femur (20/72) followed by the pelvis (11/72). Though
primary sites were uniformly distributed through the axial skeleton and the extremities, the long bones of the limbs taken together accounted for 66.6% of primary sites. Figure 1 shows a scan of a patient with primary in the left humerus and metastases in the pelvis and rib. Thirty-seven patients in all had metastases on scan; in 25 they were seen at presentation itself. The axial skeleton was most frequently involved by metastasis and the skull was the single most common site (Table 1). There was no significant difference in this distribution among the pediatric population.

In 28 patients, the bone scan showed unsuspected metastases (Fig. 2). Ten of these did have metastases suspected clinically or seen radiologically but the bone scans showed numerous other, unsuspected areas of abnormal concentration as well (see flow diagram).

Ten patients had follow-up scans (Figs. 3 and 4), eight within 1 yr of the first, and the other two between 1 and 2 yr. In five patients considered disease-free at follow-up, multiple metastases were demonstrated on scan and in another, the scan confirmed the clinical and radiological evidence of metastases.

Development of metastases seemed to be related to the site of the primary. It was found that primary disease in the axial skeleton was more frequently associated with metastatic disease (71.4%) than the proximal extremity (41.3%) or distal extremity (45.4%) (p < 0.001 by chi-square test).

In 39 patients follow-up information was obtained after the scans were performed. At 1 yr postscan, it was seen that out of 21 patients who had metastases at the time of scan, disease was controlled in only four. Twelve

---

**TABLE 1**

Primary Sites and Distribution of Metastases

<table>
<thead>
<tr>
<th>Axial skeleton</th>
<th>Proximal extremity</th>
<th>Distal extremity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvis</td>
<td>12 (7)</td>
<td></td>
</tr>
<tr>
<td>Spine</td>
<td>(4)</td>
<td>9 (5)</td>
</tr>
<tr>
<td>Ribs</td>
<td>5 (7)</td>
<td>10 (2)</td>
</tr>
<tr>
<td>Skull</td>
<td>2 (12)</td>
<td>7 (1)</td>
</tr>
<tr>
<td>Sternum</td>
<td>(1)</td>
<td>1 (—)</td>
</tr>
<tr>
<td>Clavicle</td>
<td>1 (1)</td>
<td>2 (—)</td>
</tr>
<tr>
<td>Scapula</td>
<td>1 (2)</td>
<td>—</td>
</tr>
</tbody>
</table>

* Numbers within brackets indicate frequency with which site was involved by metastases. Total no. of metastatic sites: 49; axial skeleton = 34/49 (69.3%); proximal extremity = 12/49 (24.48%); distal extremity = 3/49 (6.1%).

† Long bones of limbs were involved by primary disease in 48/72 or 66.6%.

---

**FIGURE 1**

Presented with lump on left arm. Primary in left humerus; metastases in rib and hip at presentation

**FIGURE 2**

Ewing's sarcoma: Primary anterior chest wall on right (ribs) with metastases in skull, spine, opposite rib and pelvis at presentation
were worse and five had persistent disease. In contrast, among 18 patients who had no metastases at time of scan, at 1 yr follow-up the disease was controlled in 12, only one was worse and five had persistent disease (Table 2). (This difference was significant at p <0.01 by chi-square test). The pediatric population showed a different response, in that children with metastases at first scan had a poorer prognosis than adults with metastases at first scan.

Eight patients had other organ scans. In five who had liver scans done because of hepatomegaly, three had multiple areas of decreased activity. Brain scans were done in three patients in whom raised intracranial tension was suspected on clinical grounds; one had evidence of a space-occupying lesion on scan. Alkaline phosphatase values determined in 44 patients were within normal range.

**DISCUSSION**

The value of the bone scan lies in its ability to detect skeletal involvement earlier than radiography. Since it is now evident that improved survival is possible with

<table>
<thead>
<tr>
<th>TABLE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Status at 1 yr Postscan in 39 Patients</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Adults</td>
</tr>
<tr>
<td>Children</td>
</tr>
<tr>
<td>Without metastases</td>
</tr>
<tr>
<td>Adults</td>
</tr>
<tr>
<td>Children</td>
</tr>
</tbody>
</table>
combination chemotherapy and radiotherapy (7,10,11) it is important to detect metastases in bone at presenta-
tion and follow-up, unsuspected or undemonstrated by 
other means.
Goldstein and associates in a retrospective analysis of 
bone scans in 28 patients of Ewing's sarcoma showed an 
11% incidence of metastasis at presentation, which rose 
to 45% at follow-up (9). A smaller study of nine cases of 
Ewing’s sarcoma with fluorine-18 bone scans, reported 
no metastases at presentation but two subsequently de-
veloped metastases at 2 yr follow-up (13). In another 
report on 156 cases of Ewing's sarcoma (11) 21% of 
patients had metastases at presentation detected by 
icl临ical or radiological means alone. It is possible that 
bone scans may have shown a larger incidence.
In our series, 47% had metastases at presentation 
(scanned within 6 mo of diagnosis) and 60% at follow-up 
scanning. Unsuspected sites of metastases were 
demonstrated on scan in 38.8%.
Metastases in other organs are not routinely looked 
for by scintigraphy. Our numbers are small and not 
Avough to recommend routine liver scans in all cases 
of Ewing’s sarcoma. However, it would be useful to 
perform liver scans in patients who present with 
hepatomegaly.
Presence of metastases is related to a poorer prognosis 
and the role of the bone scan in detecting them seems 
unequivocally clear. It seems reasonable to suggest that 
first visit and follow-up bone scanning should be an 
essential constituent of any management protocol for 
Ewing's sarcoma.

ACKNOWLEDGMENT

The author sincerely thanks Dr. R. S. Rao, Superintendent, 
Tata Memorial Hospital for allowing access to the case records 
of the patients referred for bone scans.

REFERENCES

1. Dahlin DC, Conventry MD, Scanlon PW: Ewing's sar-
coma—A critical analysis of 165 cases. J Bone Joint Surg 
43A:185—192, 1961
2. Bhansali SK, Desai PB: Ewing's sarcoma—Observations 
3. Falk S, Alpert M: Five year survival of patients with 
Ewing's sarcoma—Treatment and results. Cancer 34: 
143—148, 1974
4. Wang CC, Schultz MD: Ewing's sarcoma—A study of 
fifty cases treated at the Massachusetts General Hospital, 
1953
5. Philips RE, Higinbothan NL: The curability of Ewing's 
endothelioma of bone in children. J Pediatr 70:391—397, 
1967
and combination chemotherapy in advanced Ewing's 
sarcoma—Intergroup study. Cancer 47:1930—1936, 
1981
tion of prognostic factors and their influence on ther-
apeutic results in patients with Ewing's sarcoma. Cancer 
45:2213—2219, 1980
Ewing's sarcoma and considerations for future therapeu-
tic trials. Cancer 41:888—899, 1978
place for bone scanning in Ewing's sarcoma? J Nucl Med 
21:10—12, 1980
Ewing's sarcoma with combination chemotherapy (vinc-
cristine, actinomycin D, and cyclophosphamide) and 
coma—Analysis of 156 cases. Ind J Can Chemother 5: 
37—44, 1983
coma: Ten-year experience with adjuvant chemotherapy. 
Cancer 47:2204—2213, 1981
bone scintigraphy in children with osteosarcoma or 