Scintigraphic Appearance of Uncommon Soft-Tissue Osteogenic Sarcoma Metastases

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The advent of improved chemotherapy has changed the natural course of osteosarcoma. The role of bone scintigraphy in the workup of metastatic osteosarcoma is being re-evaluated. Extra-osseous osteogenic sarcoma metastases, particularly pulmonary metastases, are known to accumulate bone-avid agents. In this case, there is also uptake by noncalcified metastases to the brain and to soft tissues of the leg and arm which has not been previously reported. Correlation with computed tomography and magnetic resonance imaging is made.

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Osteogenic sarcoma (OS) is one of the most frequent forms of primary bone tumors with metastases occurring in the lungs (95%), other bones (50%), and brain (1.5%) (*1*). Radionuclide bone-seeking agents are known to localize in a percentage of extraskeletal OS metastases. Pulmonary, renal, mediastinal and pericardial metastases (*2*) and calcified brain (*1,3*), and calcified soft-tissue metastases (*4*) also have been reported to accumulate radionuclide bone agents. Although bone scintigraphy has a lower sensitivity than plain chest film and chest computed tomography (CT) for detecting lung metastases, it is more specific with virtually no false-positives (*5*). Extrapolating the high specificity of bone scintigraphy in the detection of lung metastases, an area of increased uptake in the soft tissues of the calf or proximal humerus almost certainly represents metastatic disease in a patient with OS. To our knowledge, radioisotope bone agent uptake by noncalcified brain and soft-tissue metastases is previously unreported.

CASE REPORT

This 21-yr-old male status post left above the knee amputation with a history of OS was presumed free of metastases at the time of diagnosis with a normal bone scan and chest x-ray. Unfortunately, after only one chemotherapy treatment the patient was lost to follow-up. Approximately 1 yr later he presented to the emergency room with nausea, vomiting, headache, and drowsiness. Contrasted CT scan of the brain (9800, General Electric, Milwaukee, WI) (Fig. 1) at that time revealed a large right occipital lobe mass with edema and midline shift consistent with newly diagnosed metastatic disease. He was admitted for signs of increased intracranial pressure and treated with dexamethasone for cerebral edema. He completed a 10-day course of external beam irradiation of the brain.

Chest radiography (Fig. 2) obtained during the hospitalization showed multiple lung nodules compatible with diffuse metastatic disease, although the patient was asymptomatic. The bone scan (Fig. 3) using 20 mCi of technetium-99m-methylene diphosphonate (^{99m}Tc-MDP) showed multiple areas of abnormally increased activity in the lungs and brain corresponding to the known metastatic disease in these areas. Additionally, there were unsuspected areas of increased activity in the soft tissues adjacent to the right proximal humerus and in the left calf, again compatible with metastatic disease. No bony metastases were seen. Brain magnetic resonance imaging (MRI) (MTP, Diasonics, San Francisco, CA) with gadopentetate dimeglumine (Gd-DTPA) (Fig. 4), similar to the CT and bone scintigraphy, demonstrated the large right occipital lobe brain metastasis. Calf MRI (Fig. 5) likewise

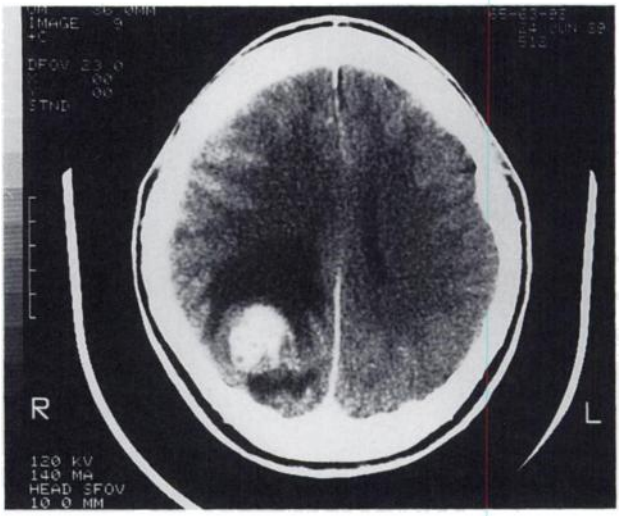

FIGURE 1
Axial CT image reveals enhancing right posterior parietal metastasis.

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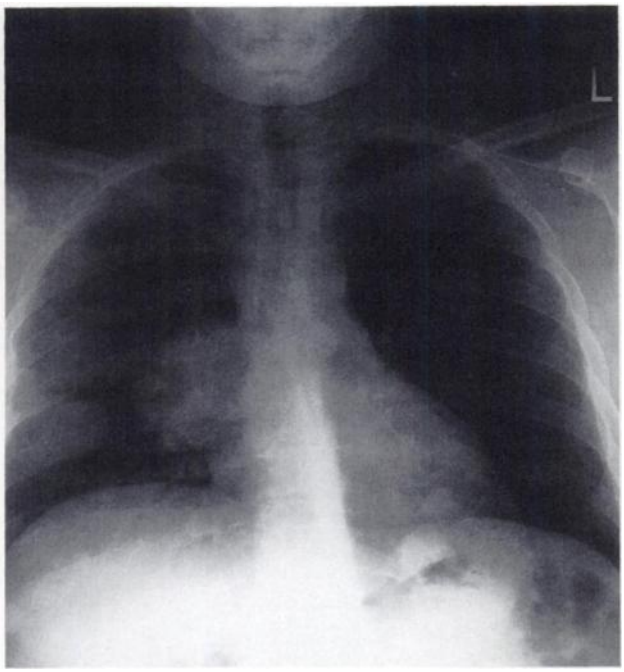

FIGURE 2
PA chest with multiple pulmonary metastases.

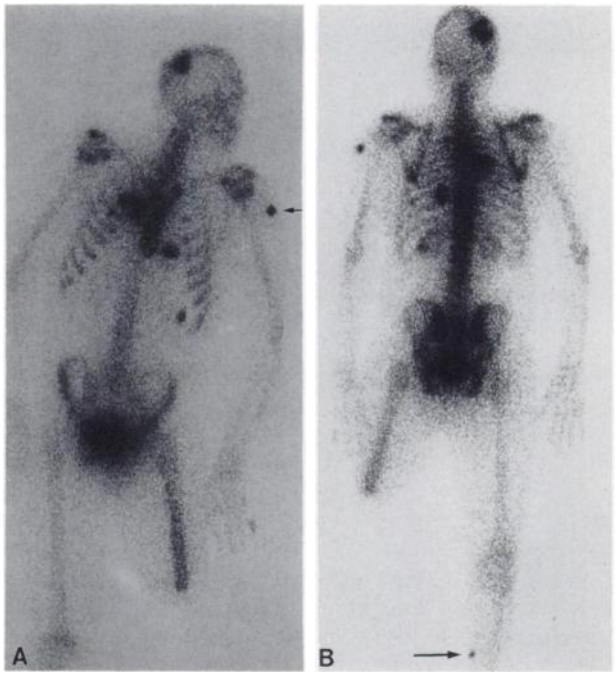

FIGURE 3
(A) Anterior image from the bone scan with multiple areas of increased soft-tissue uptake in the lung, brain, and the left proximal arm (arrow). (B) The posterior bone scan image with an additional area of increased uptake in the soft tissues of the right calf (arrow).

revealed an area of abnormal signal intensity in the superficial soft tissues corresponding to the area of abnormality on bone scan.

DISCUSSION

Determination of the presence of metastases is vital to the management of patients with osteogenic sarcoma. Multiple imaging modalities are generally necessary to define the presence and anatomic extent of these metastases. CT and MRI have largely replaced bone scintigraphy. However, the role of bone scintigraphy is being re-evaluated and is again recognized as an impor-

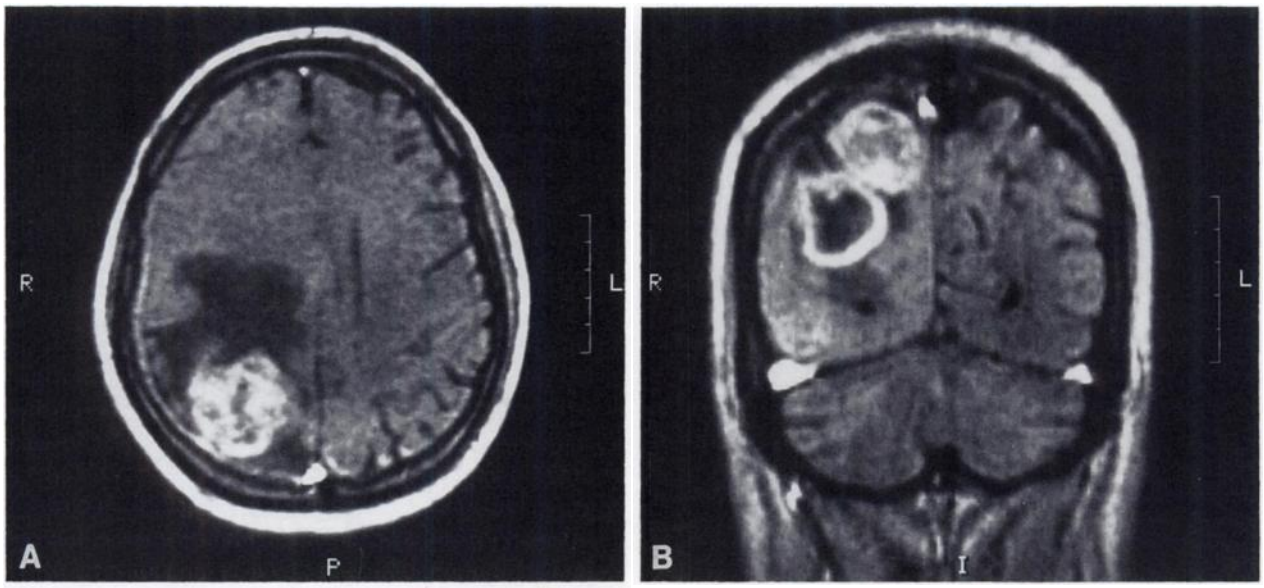

FIGURE 4
(A) MR axial image: T1-weighted (T = 0.064, TR = 68 msec/TE = 24 msec) Gd-DTPA-enhanced image showing an inhomogeneous area of increased signal intensity in the right posterior parietal lobe. (B) T1-weighted Gd-DTPA-enhanced coronal MR image (T = 0.064 TR = 68 msec/TE = 24 msec) again showing the brain metastasis with the inferior area of ring enhancement, presumably representing central necrosis.

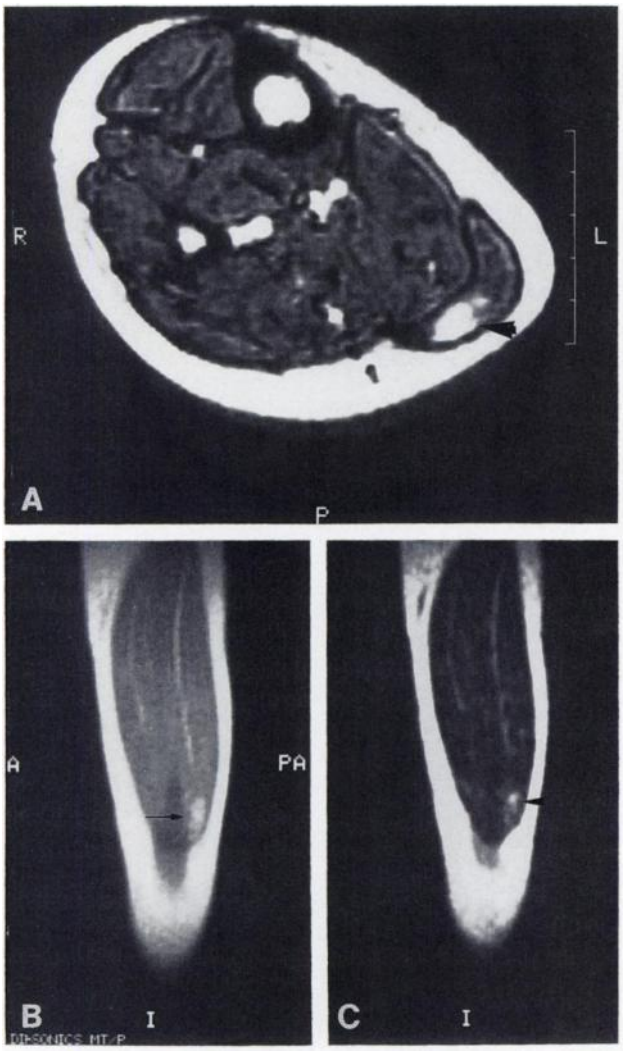

FIGURE 5
Axial partial flip T2-weighted MR image (T = 0.064, TR = 145 msec/TE = 53 msec) with an abnormal area of increased signal intensity in the posteromedial aspect of the calf (arrowhead). (B-C) Sagittal intermediate weighted MR image (T = 0.064, TR = 2000 msec/TE = 30 msec) and T2-weighted MR image (T = 0.064, TR = 2000 msec/TE = 105 msec) again showing the soft-tissue metastasis to the calf (arrow and arrowhead, respectively).

tant examination both for screening and follow-up for metastases. The use of bone scintigraphy was questioned because pulmonary metastases generally precede osseous metastases (*6*). Radiographs are more sensitive than bone scintigraphy in detecting pulmonary spread. However, bone scanning, which is more specific, may occasionally precede plain radiograph in their detection (*7*). Also, due to advances in chemotherapy, up to 16% of patients now develop bony metastases prior to pulmonary disease (*8*). Vanel et al. described bone scintigraphy as a "useless" imaging modality for the detection of pulmonary metastases, with CT as the optimal method. Although they reported no false-positives on planar bone scans there were two false-positives by single-photon emission computed tomography (SPECT) (*5*). A variety of neoplastic and benign conditions can be detected in the chest by bone scan. Lung, colon, and breast carcinoma, neuroblastoma, fibrosarcoma, seminoma, malignant pleural effusions, myositis ossificans, tuberculosis, alveolar microlithiasis, and infections may take up bone agents. In the proper clinical setting offered by this case report, the diagnosis of OS metastases may be presumed. The case presented also reveals two previously unsuspected soft-tissue metastases, further reinforcing the potential of bone scintigraphy in evaluating OS metastases.

REFERENCES

1. Danziger J, Wallace S, Handel SF, DeSantos LA. Metastatic osteogenic sarcoma to brain. *Cancer* 1979; 43:707–710.
2. Velchik MG, Wegener W. Osteogenic sarcoma with pulmonary metastasis visualized by bone imaging. *Clin Nucl Med* 1989; 14:662–665.
3. Ozarda AT, Legaspi JR, Haynie TP. Detection of a brain metastasis from osteogenic sarcoma with Tc-99m methylene diphosphonate bone scanning. *Eur J Nucl Med* 1983; 8:552–554.
4. Flowers WM. Tc-99m polyphosphate uptake within pulmonary and soft tissue metastases from osteosarcoma. *Radiology* 1974; 112:377–378.
5. Vanel D, Henry-Amar M, Lumbroso J, et al. Pulmonary evaluation of patients with osteogenic sarcoma: roles of standard radiography, tomography, CT, scintigraphy, and tomoscintigraphy. *AJR* 1984; 143:519–523.
6. Rees CR, Siddiqui AR, duCret R. The role of bone scintigraphy in osteogenic sarcoma. *Skel Radiol* 1986; 15:365–367.
7. Ghaed N, Thrall JH, Pinsky SM, Johnson MC. Detection of extraosseous metastases from osteogenic sarcoma with technetium-99m polyphosphonate bone scanning. *Radiology* 1974; 112:373–375.
8. Goldstein M, McNeil DJ, Zufall E, et al. Changing indications for bone scintigraphy in patients with osteogenic sarcoma. *Radiology* 1980; 135:177–180.