Scintigraphic Features of Primary Sacral Tumors

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The bone scan features of different types of sacral tumors in 16 patients were assessed. Four out of five patients with chordoma, the most common sacral tumor, demonstrated either reduced uptake or normal distribution of isotope at the site of this midline tumor. Plasmacytoma, which is not usually central, also caused reduced uptake on the bone scan. Ewing's sarcoma gave no consistent pattern. All other tumors caused increased uptake except for one unusual case of osteogenic sarcoma. Bone scintigraphy can be very useful in the assessment of sacral tumors. A midline sacral tumor that is cold on the bone scan is very likely to be a chordoma.

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Primary tumors of the sacrum are not common and metastatic disease is by far the most common etiology, as it is in almost all bones. When there is no known primary tumor or when the lesion is solitary and confined to the sacrum, a primary tumor must enter into the differential diagnosis. There are many varieties of primary sacral tumors.

Over the past decade, one of the authors (J.S.) has studied these rather unusual primary tumors. A study of benign tumors of the sacrum revealed that giant cell tumors were the most common benign tumor (*1*). Our data indicates that chordoma is by far the most common malignant sacral tumor, accounting for 54% of primary sacral malignancies at our institution.

Although the value of radionuclide studies in tumors of bone is generally accepted as useful, bone scans are only rarely performed for sacral tumors. A review of the literature revealed little information on the scintigraphic appearances of various sacral neoplasms (*2,3*).

Papers in the literature that address the different imaging characteristics of sacral tumors have described the various radiographic and computed tomographic (CT) appearances that may help in the differential diagnosis of the histologic type of tumor (*4–6*). There is no information on the scintigraphic features of the different types of sacral tumors. Radionuclide bone studies have the potential for aiding in the evaluation of sacral neoplasms. It was thus decided to study, retrospectively, the radionuclide images in 16 patients with different types of sacral tumors.

MATERIALS AND METHODS

Sixteen patients with primary sacral tumors who presented between 1974 and 1985 were studied. All patients had isotope bone scans performed and had histologic confirmation of tumor type within a short time following the bone scan.

Total-body images of the skeleton were obtained on a rectilinear scanner. Gamma camera views of the sacral area were also taken in 12 of the 16 patients. Most of the time, posterior images were adequate. One additional lateral view and one subpubic view were necessary to delineate the lesion in two separate patients. With the exception of one patient who had only a fluorine-18 study, technetium-99m methylene diphosphonate ([^{99m}Tc]MDP) was the radiopharmaceutical used.

In addition, an assessment was made as to the number of each type of primary tumors of the sacrum that presented to our institution between 1936 and 1983.

RESULTS

The bone scan appearance found in the various sacral tumors in this group of 16 patients is outlined in Table 1. Four out of five patients with chordoma demonstrated either reduced uptake or normal distribution of

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TABLE 1
Bone Scan Appearance and Tumor History in 16 Patients with Primary Sacral Tumors

Tumor histology	Patient	Age/Sex	Bone scan
Chordoma	1	43/F	Reduced uptake
	2	55/M	Reduced uptake
	3	55/F	Reduced uptake
	4	65/M	No bone reaction
	5	52/M	Increased uptake
Plasmacytoma	6	57/M	Reduced uptake
	7	54/M	Reduced uptake
Ewing's sarcoma	8	16/F	Increased uptake
	9	13/F	Reduced uptake
	10	18/M	No bone reaction
Osteogenic sarcoma	11	15/M	Increased uptake
	12	66/M	Increased uptake
	13	17/M	Increased uptake
	14	60/F	Reduced uptake
Chondrosarcoma	15	22/M	Increased uptake
Benign giant cell tumor associated with Paget's disease	16	66/M	Increased uptake

TABLE 2
Primary Tumors of Sacrum Presenting to Memorial Sloan-Kettering Cancer Center Between 1936 and 1983

Benign		Malignant	
Giant cell tumor	20	Chordoma	55
Giant cell tumor associated with Paget's disease	2	Osteosarcoma	9
		Chondrosarcoma	8
		Ewing's sarcoma	6
Benign osteoblastoma	5	Lymphoma of bone	5
Aneurysmal bone cyst	5	Plasmacytoma	5
Osteochondroma	3	Neurogenic sarcoma	4
Osteoma	1	Spindle cell sarcoma	3
Total	36	Radiation-induced sarcoma	2
		Paget's sarcoma	2
		Fibrosarcoma	2
		Malignant giant cell tumor	1
		Total	102

isotope at the site of this tumor. The radiographic appearance of these tumors is also shown (Figs. 1 and 2). The area of reduced uptake appears to correspond to the bulk of tumor demonstrated by the radiographic studies. Bone reaction in the periphery of tumor was noted in two patients. Plasmacytoma also caused reduced uptake on the bone scan in the two patients with this tumor (Fig. 3). Ewing's sarcoma gave no constant pattern, commonly seen with this malignancy at other sites (7–9). The other tumors in our study caused increased uptake except for one unusual case of osteogenic sarcoma.

Table 2 enumerates the different primary tumors of the sacrum that have been treated at our institution between 1936 and 1983. Chordoma is by far the most common malignant tumor of the sacrum accounting for about half of all malignant sacral neoplasms. Chordoma is a central tumor that arises from aberrant rests of the notochord.

DISCUSSION

Most bone tumors cause increased tracer uptake on the bone scan. Our findings indicate that in a patient with a central sacral tumor that demonstrates reduced

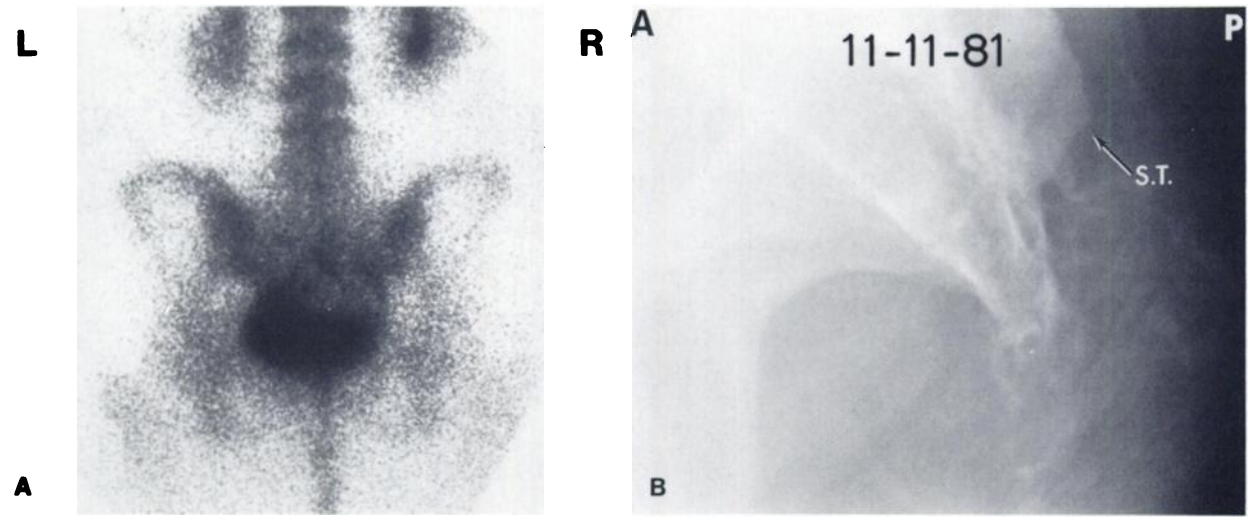

FIGURE 1
A: Posterior pelvic view of Patient 1. Bone scan demonstrates reduced tracer uptake at site of sacral tumor, with surrounding rim of bone reaction. Large chordoma was resected following this scan. B: Lateral x-ray of sacrum demonstrates sacral chordoma in this patient. Sacral tumor (ST) is indicated with an arrow

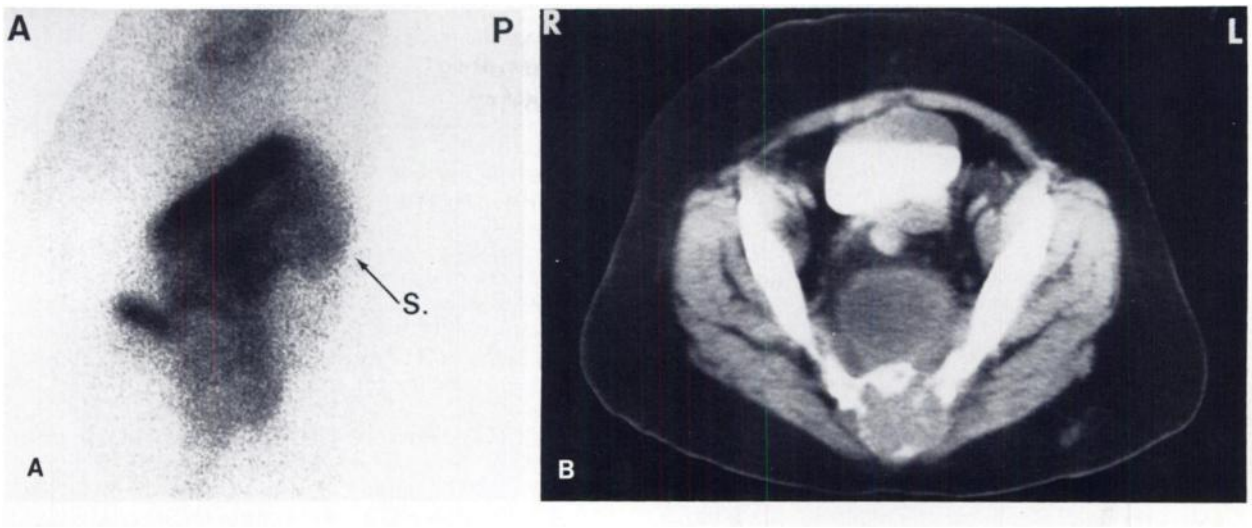

FIGURE 2
A: Lateral view of Patient 4 demonstrates no bone reaction in sacrum (S), (arrow), at site of sacral chordoma. B: Pelvic CT clearly demonstrates sacral chordoma in this patient

uptake on the bone scan, chordoma is the most likely diagnosis. Chordoma causing reduced tracer accumulation on bone scintigraphy has been noted elsewhere (*2,3*). The other diagnosis that must be considered if a cold lesion is detected on the bone scan is plasmacytoma. Both patients with plasmacytoma in our series had photopenic lesions on bone scan. Chordomas are midline sacral tumors, whereas plasmacytomas are usually peripheral. In addition, 50% of patients with plasmacytoma have characteristic serum or urine electrophoresis, and these should be performed if this diagnosis is considered. Possible explanations for the cause of reduced uptake on the bone scan in chordoma and plasmacytoma are either interruption of the bone blood supply by the tumor, thus impeding the uptake of tracer by the bone, or gross bone destruction causing bone loss and thus a lack of reactive bone tissue in the region of the tumor.

Good visualization of the sacrum is essential when bone scintigraphy is performed for evaluation of a known sacral tumor. The bladder must be empty of urine. In addition to a routine posterior view of the pelvis, further views should be obtained such as a lateral view and a subpubic view, in which the patient sits above the gamma camera head, for full assessment of the sacrum (*10,11*).

In conclusion, bone scintigraphy can be very useful in the assessment of sacral tumors. A midline sacral tumor that is cold on bone scan is very likely to be a chordoma.

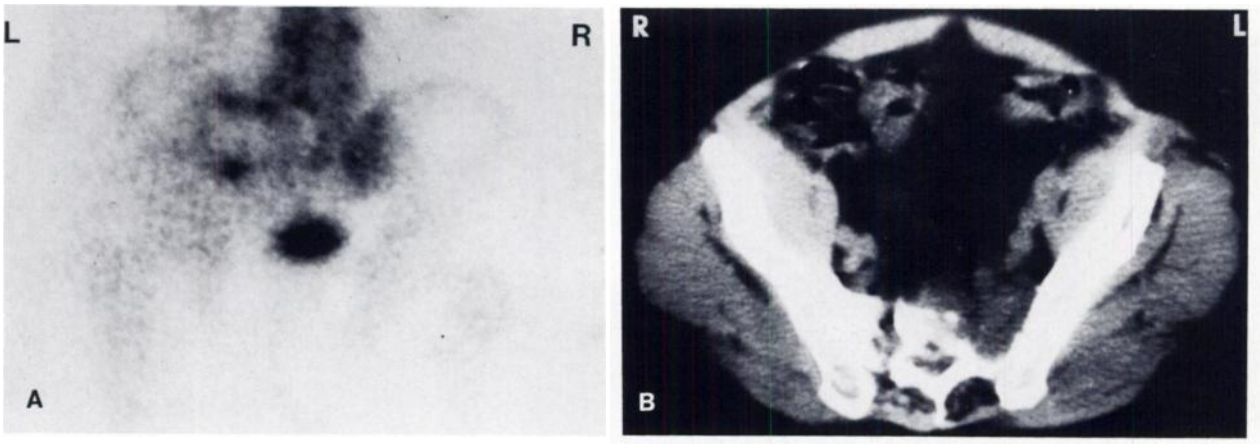

FIGURE 3
A: Posterior pelvic view of Patient 6 with sacral plasmacytoma. Photopenic lesion is seen involving left side of sacrum and left sacroiliac joint. B: Pelvic CT scan demonstrates destructive lesion in this region

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REFERENCES

1. Smith J, Wixon D, Watson RC: Giant-cell tumor of the sacrum: Clinical and radiologic features in 13 patients. *J Can Assoc Radiol* 30:34–39, 1979
2. Shih WJ, Reba RC, Huang TY: Scintigraphic photopenia in sacrococcygeal chordoma. *Eur J Nucl Med* 8:279–280, 1983
3. Hudson TM, Galceran M: Radiology of sacrococcygeal chordoma. Difficulties in detecting soft tissue extension. *Clin Orthop* 175:237–242, 1983
4. Turner ML, Mulhern CB, Dalinka MK: Lesions of the sacrum. Differential diagnosis and radiological evaluation. *JAMA* 245:275–277, 1981
5. Luken MG, Michelsen J, Whelan MA, et al: The diagnosis of sacral lesions. *Surg Neurol* 15:377–383, 1981
6. Firooznia H, Pinto RS, Lin JP, et al: Chordoma: Radiologic evaluation of 20 cases. *Am J Roentgenol* 127:797–805, 1976
7. Bushnell D, Shirazi P, Khedkar N, et al: Ewing's sarcoma seen as a "cold" lesion on bone scans. *Clin Nucl Med* 8:173–174, 1983
8. Frankel RS, Jones AE, Cohen JA, et al: Clinical correlations of Ga-67 and skeletal whole-body radionuclide studies with radiography in Ewing's sarcoma. *Radiology* 110:597–603, 1974
9. Weingrad T, Heyman S, Alavi A: Cold lesions on bone scan in pediatric neoplasms. *Clin Nucl Med* 9:125–130, 1984
10. Epstein DA, Stern H: The lateral view in radionuclide imaging of the sacrum. *Radiology* 123:704, 1977
11. Hughes J: Techniques of bone imaging. In *Bone Scintigraphy*, Silberstein EB, ed. Mount Kisco, New York, Futura Publishing Company, 1984, pp 61–67