

BONE SCAN IN PRIMARY HYPERPARATHYROIDISM

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Four patients with primary hyperparathyroidism due to parathyroid adenoma, chief cell type, manifested some bone scan abnormalities not unlike the distribution of abnormally increased activity of dialysis patients with the secondary type. Bone scan using $^{99m}\text{TcSn}$ -polyphosphate or any of the newer ^{99m}Tc -labeled phosphates is recommended in patients with hypercalcemia or suspected hyperparathyroidism.

We recently observed abnormal bone scan findings in patients who had clinical and biochemical evidence of secondary hyperparathyroidism during chronic dialysis for end-stage renal failure (1). In 1969, Evens, Ashburn, and Bartter described a limited ^{85}Sr facial scan on a patient with parathyroid carcinoma (2); however, total-body scan findings using ^{99m}Tc -complexed polyphosphate agents in primary hyperparathyroidism have not been previously reported. This communication describes abnormal bone scan findings in four patients who had tissue diagnoses of primary hyperparathyroidism.

PATIENTS AND METHODS

Table 1 summarizes the clinical, laboratory, and surgical-pathologic data of the four patients. All were adult females with biochemical findings of hypercalcemia, hypophosphatemia, and elevated serum alkaline phosphatase. Total-body scanning was performed 3 hr after the intravenous administration of 15 mCi of $^{99m}\text{TcSn}$ polyphosphate (New England Nuclear) using an Ohio-Nuclear 84 5-in. dual scanner. Photoscans of the hands were also obtained on Patients 2, 3, and 4. Concurrent roentgenographs included at least the skull, mandible, chest, shoulders, and hands, and in Patients 1, 3, and 4, spine and pelvis roentgenographs were also taken. All four patients underwent exploratory neck surgery.

RESULTS

Abnormally increased activity in the calvarium, mandible, and sternum was found in all four patients (Fig. 1). The abnormal activity in the calvarium is heavier along the periphery and appears more diffuse centrally. Increased activity in the mandible is diffusely homogeneous. The acromioclavicular areas and the distal portion of the femur, especially the lateral epicondyles, also showed abnormally increased activity in Patients 2, 3, and 4, as did the lumbar vertebrae and iliac crests of Patients 2 and 4 (Fig. 2). Roentgenographic findings are listed in Table 1.

DISCUSSION

The skeletal radionuclidic distribution in patients with primary hyperparathyroidism is not unlike the scan abnormalities found in secondary hyperparathyroidism except for the generally more extensive and severely abnormal bone activity in most of the patients receiving chronic dialysis. Another apparent difference is that in primary hyperparathyroidism the kidneys are outlined whereas in those with the secondary type, because of the end-stage renal disease, there was no kidney visualization.

As in secondary hyperparathyroidism the concurrent roentgenographs obtained on these four patients disclosed generally negative or very minimal findings. All four showed abnormally heavy activity in the calvarium, mandible, and sternum, and yet roentgenographs of these regions were unremarkable. The acromioclavicular areas showed marked increase in activity on scan in Patients 2, 3, and 4 whereas the corresponding roentgenographs of these areas were normal.

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TABLE 1. CLINICAL AND LABORATORY DATA

Pa-tients	Age and Sex	Clinical findings	Cal-cium (mg%)	Phos-phorus (mg%)	Alkaline phos-phatase (I.U.)	X-ray findings*	Surgical-pathologic findings
1	47F	Hip and knee joint pain; generalized discomfort, easy fatiguability, and nausea	13.1	2.2	470	Suspicious subperiosteal bone resorption-cortex of left third finger. Remainder-Neg.	Parathyroid adenoma; chief cell type
2	33F	Hypercalcemia found fortuitously prior to hysterectomy for abdominal pain	14.2	2.1	193	Negative	Parathyroid adenoma; chief cell type
3	66F	Generalized weakness; headache and constipation	11.7	3.0	190	Negative	Parathyroid adenoma; chief cell type with some cystic changes
4	65F	Low back pain; large calculus in the right kidney	11.9	2.3	138	Minimal bony demineralization of phalanges. Remainder-Neg.	Parathyroid adenoma; chief cell type with fibrosis.

* Includes at least x-rays of the skull, mandible, shoulders, chest, and hands. Numbers 1, 3, and 4 also include x-rays of spine and pelvis.

This unequivocal increase in activity on scan and the paucity of corresponding roentgenographic changes tend to underscore the more sensitive, although perhaps less specific, character of bone scan when compared with roentgenography in evaluating disease of the skeletal system. It has been shown that 10–40% of patients with bone metastases have a negative skeletal survey when the bone scan showed abnormal findings (3). These data are based on ^{85}Sr bone scans and it is conceivable that the actual figure for positive scans in osseous metastases may even be higher when $^{90\text{m}}\text{Tc}$ -labeled phosphate agents are used although statistics on this still appear to be incomplete.

Metastatic disease as it appears on bone scan is



FIG. 1. Heavy activity in calvarium, mandible (arrow), and sternum (Patient 1).

usually asymmetric and randomized in its localization, which is in sharp contrast with the scan findings in hyperparathyroidism. Paget's disease, which could account for abnormal skull findings similar to those seen in Patient 1, likewise tends to have more pronounced, focalized, asymmetric activity and usually lacks the generalized nature of increased activity of hyperparathyroidism. The latter, because it is a general endocrine disorder, usually manifests symmetric osseous involvement while showing comparable extent of disease in the abnormal activity of corresponding bones. The mandible invariably manifests some of the early changes in hyperparathyroidism whether this be of the primary or secondary type. This mandibular activity was also noted in the less severely affected chronic dialysis patients who manifested evidence of secondary hyperparathyroidism (1). This finding appears to be significant not only because the mandible is not a usual site for diffuse metastases (4) but also because changes in the rami and body of mandible in instances of hyperparathyroidism are not commonly observed findings on x-ray film (5).

In the case reported by Evens, et al the abnormal mandibular activity in their patient was not due to metastatic disease but rather to a "brown tumor" and the surrounding adjacent bone (2). This difference in the mandibular findings from our four patients may be partly due to the absence of comparable benign tumor pathology in our patients and also to the difference in the dose and agents used in obtaining the scan.



FIG. 2. Note generalized increased activity in calvarium, mandible, sternum, lumbar vertebrae. Note also symmetry of increased activity distribution in acromioclavicular joints, lateral epicondyles (arrows), and pelvis (Patient 3).

The abnormal scan findings in hyperparathyroidism have been anticipated by earlier works. Dymling has shown that a markedly increased accretion rate with ^{47}Ca and ^{85}Sr exists in patients with hyperparathyroidism (6) and similar studies have been reported by other investigators (7,8). Additional support of this scan abnormality is derived from animal data. Costeas, et al showed that the administration of parathyroid hormone resulted in 60% increased uptake of ^{18}F in rabbit tibias (9).

Experience based on these four cases and on previously observed chronic dialysis patients prompts us to recommend the use of bone scanning with

$^{99\text{m}}\text{TcSn}$ -polyphosphate or perhaps other new phosphate polymers in the workup of patients with suspected hyperparathyroidism. Whenever generalized symmetrical abnormal bone activity is present, particularly in the calvarium, mandible, sternum, and epiphyses of long bones with or without accompanying changes in the vertebrae and pelvis, hyperparathyroidism should be suspected.

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