Bone Scan Findings in Hypervitaminosis D: Case Report

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Bone scans in three patients showed generalized symmetrical increased uptake of radiopharmaceutical by the skeleton and absent or faint kidney images. It is thought that these appearances may be attributable to excess vitamin D, but other possible contributing factors, including the presence of renal osteodystrophy, are discussed.

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The use of bone scanning to evaluate the presence of metastatic malignancy within the skeleton is well known but its role in the diagnosis of metabolic disease is not yet established. As more experience is gained, however, patterns associated with these diseases are becoming apparent and may aid in the identification and interpretation of the disease process involved (*1–4*).

Bone-scan findings in hypervitaminosis D have not been previously reported. This communication describes the appearances in three patients who had proven hypervitaminosis D.

METHOD

Multiple views of the skeleton were recorded on Polaroid film with a gamma camera fitted with a high-resolution, medium-sensitivity collimator. In addition, images and counting rates were stored on magnetic tape. Spinal views were obtained with 300,000 counts, and all other views with a minimum of 100,000 counts. Bone images were recorded 4 hr after the intravenous injection of 7–15 mCi of Tc-99m HEDP, the dose being adjusted according to body weight.

Patient 1. A 15-year-old boy had chronic renal failure secondary to obstructive uropathy. In March 1976 he was found to have biochemical evidence of renal osteodystrophy and was started on Calciferol, 1.25 mg/day. In November 1976 his serum calcium on routine testing was found to be 3.05 mmol/l (normal 2.2–2.6), and his Vitamin D therapy was discontinued. On questioning he admitted to having some thirst, but had no other symptoms of hypercalcemia. A radiologic skeletal survey was normal. Relevant biochemical data were: serum phosphorus 1.45 mmol/l (0.8–1.4), alkaline phosphatase 625 units/l (<280), albumin 47 g/l, globulin 37 g/l, urea 12 mmol/l (<7), creatinine 300 μmol/l (<115), creatinine clearance 20 ml/min, 25-hydroxy-cholecalciferol (H.C.C.) 146 ng/ml (<25), and parathormone level (P.T.H.) 240 ng/l (<550). The bone scan was performed 6 days after presentation.

Patient 2. This patient was diagnosed as having vitamin-D-resistant hypophosphatemic rickets at the age of 2 yr. She was initially treated with 8.75 mg Calciferol per day but since age 7 has received an average of 1.87 mg per day. In November 1976, at age 12, she was referred to be considered for therapy with 1-alpha-hydroxy Vitamin D3. She was asymptomatic and, although small for her age (1.34 meters), had no obvious bony deformity.

At admission, her serum calcium was found to be elevated to 2.9 mmol/l. On reviewing her previous radiologic skeletal surveys, we found that these showed gross rickets between the ages of 2 and 7 yr, but x-rays obtained at the ages of 9 and 12 were normal. A further radiologic skeletal survey in November 1976 showed sclerotic changes in her spine and pelvis, which were attributed to her hypervitaminosis D. Renal function was normal, as assessed by blood urea and creatinine clearance. Her serum phosphorus was 1.3 mmol/l, alkaline phosphatase 809 units/l, albumin 48 g/l and globulin 24

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g/l, 25 H.C.C. 195 ng/ml, and P.T.H. less than 180 ng/l. The bone scan was performed 4 wk after presentation.

Patient 3. A 27-year-old man with chronic renal failure secondary to obstructive uropathy and chronic pyelonephritis had an ileal conduit performed in 1971 because of bladder-neck obstruction. Since that time he has been treated for recurrent urinary-tract infections. Dihydrotachysterol (AT10), 0.5 mg per day, was started in November 1973 because of biochemical evidence of renal osteodystrophy. He was complaining of muscular cramps at that time but had no bone pain. His therapy was changed to Calciferol 2.5 mg per day in February 1976, and in December of that year his calcium was found to be 2.9 mmol/l. He was asymptomatic at that time and his radiologic skeletal survey was normal. His serum phosphorus was 1.5 mmol/l, alkaline phosphatase 146 units/l, albumin 46 g/l, globulin 20 g/l, urea 20.7 mmol/l, creatinine 840 μmol/l, creatinine clearance 19 ml/minute, 25 H.C.C. 195 μg/ml and P.T.H. less than 190 ng/l. The bone scan was performed 3 wk after presentation.

RESULTS

In all patients the counting rates over the lumbosacral spine were abnormally increased, indicating high skeletal uptake of the radiotracer. The scans appeared to be of excellent quality due to high skeletal uptake and low soft-tissue background levels. In all patients, increased activity was present in the calvarium, mandible, vertebrae, acromio-clavicular area, pelvis, ribs, and long bones.

Patients 2 and 3 showed no radioactivity in the kidneys (Fig. 1) and bladder, but Patient 3 had some radioactivity over the site of his ileal conduit. In Patient 1 the kidneys were faintly visible, the left more so than the right, and they both appeared enlarged. In this case the bladder also appeared to be enlarged, the picture being consistent with obstructive uropathy.

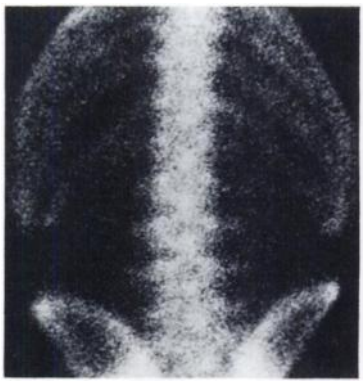

FIG. 1. Patient 2. Lumbo-sacral spine shows high skeletal uptake; kidney images are not seen.

DISCUSSION

The bone-scans in these three patients with hypervitaminosis D all had high target-to-background ratios. The calvarium and mandible appear particularly hot. In two patients, the kidneys and bladder were not visualized at all, and in the third were only faintly outlined. These findings are very similar to those previously described by Sy and Mittal in chronic dialysis patients with renal osteodystrophy, in whom the scan appearances were attributed to secondary hyperparathyroidism (*2*).

It is known that there is a striking accumulation of radiopharmaceutical in the epiphyseal growth centers in children (*5*), and as Patient 2 was only 12 yr old, one might expect higher skeletal retention than in an adult. This alone, however, could not explain the absent kidney images. This patient also had had proven rickets in the past, but had been adequately treated from an early age and had a normal radiologic skeletal survey in recent years.

Transileal bone biopsies were performed in all three patients within one week of the discovery of the elevated serum calcium. Decalcified and undecalcified sections were prepared, but quantitative histologic analysis was not carried out. The findings were: Patient 1 showed an increase in the extent but not in the thickness of osteoid (both lamellar and woven) with a normal calcification front. Osteoclastic resorption was increased and there were foci of woven bone and marrow fibrosis. In Patient 2 the biopsies were technically unsatisfactory, but an increase in the extent of osteoid with a normal calcification front was noted. Osteoclastic resorption was slightly increased and woven bone was present. In Patient 3 the only abnormality noted was the presence of woven bone subperiosteally with occasional foci in the trabeculae. There was no increase in osteoid or osteoclastic resorption.

It was considered there was histologic evidence of "hyperparathyroidism" in Patients 1 and 2, with evidence of increased bone turnover in Patient 3, as indicated by the presence of woven bone. Experimentally, vitamin D has been shown to be a potent stimulator of bone resorption (*6*), and in view of the normal parathormone levels, the increased bone turnover in all three patients might have been due to the presence of excess vitamin D. The bone-scan appearances described above may, therefore, be attributable to hypervitaminosis D, although the relative contribution of the underlying condition in each case is uncertain. Although these appearances are most commonly seen in renal osteodystrophy and

may represent secondary hyperparathyroidism, they are non-specific and represent rapid bone turnover from whatever cause.

REFERENCES

1. ROSENTHALL L, KAYE M: Technetium-99m-Pyrophosphate kinetics and imaging in metabolic bone disease. *J Nucl Med* 16: 33–39, 1975

2. SY WM, MITTAL AK: Bone scan in chronic dialysis patients with evidence of secondary hyperparathyroidism and renal osteodystrophy. *Br J Radiology* 48: 878–884, 1975

3. WIEGMANN T, ROSENTHALL L, KAYE M: Technetium-99m-Pyrophosphate bone scans in hyperparathyroidism. *J Nucl Med* 18: 231–235, 1977

4. KRISHNAMURTHY GT, BRICKMAN AS, BLAHD WH: Technetium-99m-Sn-Pyrophosphate pharmacokinetics and bone image changes in parathyroid disease. *J Nucl Med* 18: 236–242, 1977

5. BELL EG, MAHON DF: "Bone." In *Nuclear Medicine in Clinical Paediatrics*, Handmaker H, Lowenstein JM, eds. New York, The Society of Nuclear Medicine Inc., 1975, p 137

6. REYNOLDS JJ, HOLICK MF, DELUCA HF: The effects of Vitamin D analogues on bone resorption. *Calc Tiss Res* 15: 333–339, 1974

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