Pulmonary Uptake of Tc-99m-Labeled Methylene Diphosphonate in a Patient with a Parathyroid Adenoma

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Intense diffuse uptake of Tc-99m-labeled methylene diphosphonate was seen in both lungs of a patient submitted to surgery for a primary parathyroid adenoma. Five scans performed over the 3 yr following the operation showed persistence of lung uptake despite restoration of normal blood calcium concentration. Mild chronic renal failure caused by the hypercalcemia also persisted postoperatively. The present case confirms that pulmonary uptake of a bone tracer can occur asymptomatically when both hypercalcemia and renal failure are present. Lung uptake of a bone tracer probably reflects tissue deposition of hydroxyapatite rather than of amorphous structures. Correction of the hypercalcemia failed to resolve the abnormal scan pictures.

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Over recent years bone imaging with technetium-labeled tracers has gained increasing acceptance for the diagnosis and follow-up of many bone and joint diseases. Several reports of unusual soft-tissue uptake patterns have appeared (*1–8*). In our medical center, where approximately 7,000 bone scans have been performed, three patients have been seen with pulmonary uptake of Tc-99m-labeled methylene diphosphonate (Tc-99m MDP). Uptake was focal in two of the patients, but bilateral and diffuse in the third patient, who had a primary parathyroid adenoma. The present report concerns this third patient, in whom pulmonary images were followed over the 3 yr following removal of the tumor. A total of five anterior and posterior scans were performed with a total-body imager, 3 hr after the injection of 15 mCi of Tc-99m MDP.

CASE REPORT

The patient was a 63-yr-old woman. The only noteworthy feature of her history was childhood poliomyelitis, which had left her with paralysis of the left arm. During her first hospital admission in 1975 for digestive disorders, gallstones were discovered and a cholecystectomy was performed. The patient was anemic at this time but no cause could be found. Renal function was normal. Her condition deteriorated and she was admitted again in 1977. A diagnosis of renal failure associated with hypercalcemia was established (Table 1). On physical examination a palpable nodule was noticed in the neck. Blood pressure was 135/70 and pulse 86. Radiography showed osteodystrophy of the skull, and subperiosteal resorption in the phalanges. An i.v. urogram revealed a calycine stone in the left kidney with no evidence of nephrocalcinosis. Chest radiograph was normal, as was blood gas analysis: blood p_{O_2} 96 mm Hg; blood p_{CO_2} 36 mm Hg; oxyhemoglobin saturation 95%; plasma pH 7.4; arterial whole-blood CO_2 content 23 mmol/l. Tc-99m MDP scanning showed increased uptake in the skull but no other skeletal changes. Diffuse radioactivity was noted in both lungs (Fig. 1). Because of an elevated plasma parathyroid-hormone level and increased urinary cAMP excretion, exploratory surgery of the neck was done. A single parathyroid tumor, weighing 10.7 g, was removed. The other three glands were normal. Histologic examination confirmed that the tumor was an adenoma. Microscopically, a bone fragment removed from the iliac crest at operation showed numerous, large spaces around osteocytes, and increased osteoclast resorption.

Following operation the clinical course has been uneventful, with no sign of major disease. The patient leads a normally active life. Blood calcium concentration returned to normal (2.21 mmol/l) and has remained so in the absence of any subsequent therapeutic measures. A mild renal failure persists but has stabilized (Table 1). Five repeat scans, performed over a 3-yr period, have shown persistent diffuse pulmonary uptake with no pronounced change in density (Fig. 1).

DISCUSSION

In the present case, a diagnosis of primary parathyroid adenoma could be established with certainty on the strength of the operative findings, the cell structure in the bone, and the subsequent course. Postoperative persistence of mild renal failure is not a rare occurrence in cases such as this. The parathyroid hormone level did not return to normal postoperatively owing to the secondary parathyroid hyperplasia caused by the chronic renal failure itself. The main interest of this case is the finding of strikingly intense diffuse uptake of Tc-99m MDP in both lungs, a finding all the more remarkable in that there were no clinical or radiographic

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TABLE 1. BIOCHEMICAL FINDINGS

	Normal	Before operation	After operation				
			2 mo	6 mo	9 mo	20 mo	36 mo
Calcium (mmol/l)	2.35–2.65	3.9	2.21	2.47	2.47	2.55	2.36
Phosphates (mmol/l)	0.80–1.45	1.18	1.15	1.28	1.18	1.26	0.87
Creatinine (μmol/l)	50–110	203	150	150	115	119	117
Creatinine clearance (ml/min)	75–126	28	—	39	—	48	43
TRP (%)	⩾85	55	—	83	—	—	81
Parathyroid hormone (U/l)	1.11–3.79	7.6	—	—	—	—	5.41

abnormalities nor changes in blood-gas data. Lung biopsy was not felt to be warranted, since the abnormal scanning picture was an isolated finding and since respiratory function was normal. A diagnosis of pulmonary metastatic calcification was held likely in the light of data reported in the literature.

Two cases of parathyroid adenoma with bilateral pulmonary uptake of a technetium-labeled diphosphonate tracer have been reported (*9,10*). In both cases hypercalcemia and renal failure were present, but unfortunately the outcome was rapidly fatal and no follow-up studies could be done. Autopsy revealed diffuse pulmonary microcalcifications that had escaped radiographic detection. The present case sheds more light on the problem raised by these two cases in that for the first time the subsequent outcome of diffuse lung uptake could be observed in a patient after removal of a parathyroid adenoma.

Pulmonary uptake has been reported in a case of breast cancer with multiple bony metastases described by Watson (*11*), but in this case the uptake images disappeared after correction of hypercalcemia. In the present case, restoration of normal blood calcium was not accompanied by resolution of the metastatic calcification. One possible explanation for the abnormally persistent lung images could be the chronic renal failure. Indeed, pulmonary calcifications have been found at autopsy in 60 to 75% of patients with chronic renal failure (*12,13*), and in many of these cases the calcifications had produced no clinical or radiologic signs before the patient's death. The absence of radiologic abnormalities in the present case, therefore, is not surprising. Even with bone-seeking radiopharmaceuticals, metastatic calcifications in uremic patients are not consistently detected (*14,15*). This could be because, as Conger has shown (*16*), technetium-labeled bone tracers have poor affinity for amorphous visceral calcifications. As this same investigator has shown, however, they do have extremely high affinity for hydroxyapatite crystals. There is one clinical situation in which, as de Graaf has suggested, hydroxyapatite crystals might form in the lung: it occurs when hypercalcemia coexists with renal failure. In this respect, it is interesting that most reported cases of diffuse lung uptake of a bone tracer—whatever the underlying disease—feature the coexistence of renal failure and hypercalcemia (*9*). A scanning picture of diffuse lung uptake, therefore, is not specific to hyperparathyroidism and does not obviate the need for exploratory surgery of the neck in patients with suspected parathyroid adenoma. Nor, as the present case shows, is such a picture necessarily accompanied by respiratory failure, nor is the outcome necessarily fatal, as it can be in cases of pulmonary calcification due to calciphylaxis seen in patients with chronic renal failure (*17*).

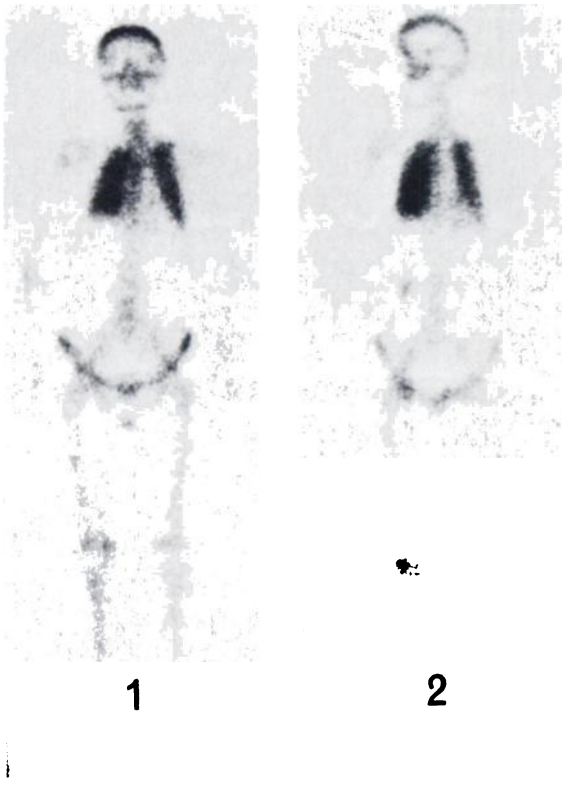

FIG. 1. Bone scans 3 hr after injection of 15 mCi of Tc-99m MDP. Scan No. 1 was performed 10 days before removal of a parathyroid adenoma; scan no. 2, 3 yr after operation. Dense diffuse uptake is seen in both lungs in the two scans. (Left arm was paralyzed by polio.)

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