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Uptake of ^{99m}Tc -Pyrophosphate by Metastatic Extragenital Seminoma

Technetium-99m-labeled pyrophosphate, polyphosphate, and diphosphonate often localize in tissues outside the skeleton and renal system. Intrathoracic extraosseous concentrations of these agents have been reported in several conditions, including squamous-cell carcinoma of the lung (1,2), myocardial infarction (3,4), malignant pleural effusions (5), and lymphosarcoma (1). Localization in some cases was associated clearly with pathologic calcification (6,7), but in others the uptake mechanism remains obscure. The present communication describes a case of ^{99m}Tc -pyrophosphate concentration in lung metastases from an extragenital seminoma.

A 46-year-old man, previously treated with radiotherapy for seminoma, was referred for a bone scan in December 1974 to evaluate a recurrent backache.

In 1961 the patient had presented with pain in the left loin and left iliac fossa. At laparotomy a large mass of matted nodes, involving the upper left ureter, was found in the retroperitoneum. Tuberculosis was suspected and the patient was treated with streptomycin, but the laboratory tests for tuberculosis were all negative. The biopsy specimen was necrotic, and histologically the lesion was attributed to chronic pyogenic inflammation.

After remaining well for 11 years, the patient had a recurrence of left iliac fossa pain. Relevant clinical findings were a nonfunctioning left kidney, as shown by ^{131}I -Hippuran renogram and intravenous pyelogram, a normal blood urea level (26 mg/dl), normal testes, and a normal chest radiograph. Laparotomy revealed a large mass of nodes at the same site as in 1961. Biopsy specimens contained large cells, each having a clear cytoplasm with a large centrally placed nucleus and prominent nucleoli. A diagnosis of typical seminoma was made.

In addition, the tumors showed areas of degeneration and necrosis. When the 1961 sections were reviewed, the features were identical with those of the necrotic areas of tumor in the 1973 sections. The patient was treated with radiotherapy, the testes being included in the treatment field. He resumed a normal life until the backache returned in November 1974.

A whole-body bone scan was undertaken 3 hr after the injection of 8 mCi of ^{99m}Tc -pyrophosphate, and selected areas of interest were imaged 2 hr later with a scintillation camera. Areas of abnormal skeletal uptake were detected in the lumbar vertebrae and right sacroiliac region. In addition, two well-defined areas of uptake were seen in the lungs (Fig. 1A). The left kidney was not seen, but the right kidney and bladder were clearly visible. There were no other areas of abnormal uptake. A chest radiograph (Fig. 1B) taken 6 days later revealed a large metastasis, 9×11 cm, in the right lung and a smaller metastasis, 5.5×5.5 cm, in the left lung, both corresponding in size and position with the lesions detected during bone scanning. At this time the patient had a blood urea concentration of 23 mg/dl. Fifteen days later, on completion of radiotherapy, a chest radiograph showed that the lesions in the right and left lungs had decreased in size to 5×5.5 cm and 3.5×3.5 cm, respectively. The condition of the patient deteriorated rapidly, however, and he died 13 days later.

At autopsy, a large soft reddish-gray tumor mass was found to extend from the left renal vein down the posterior abdominal wall and into the pelvis. To this mass were stuck the hydronephrotic left kidney, parts of the stomach, the small gut, pancreas, and the splenic flexure of the colon. There was tumor involvement of the lower half of the left kidney, the left renal vein, and the lower lumbar vertebral bodies, with metastatic tumor in the para-aortic lymph nodes and also in a single mediastinal node (Fig. 2). In the lower lobe of the right lung there was a 6-cm-diameter tumor nod-

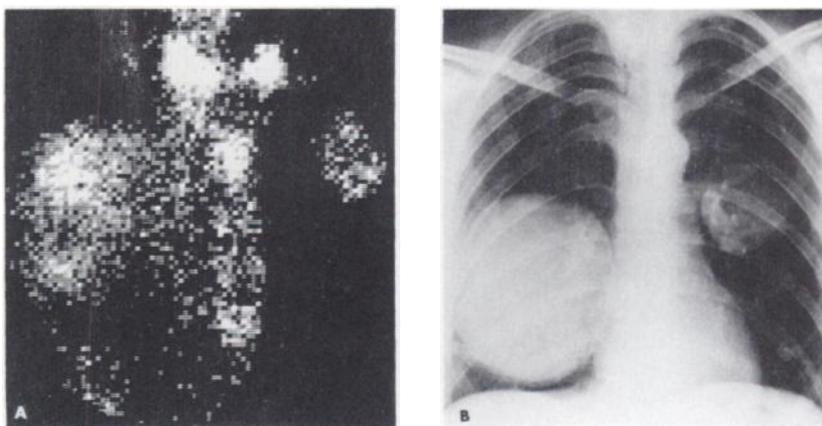


FIG. 1. (A) Anterior chest scan using ^{99m}Tc -pyrophosphate. In addition to sternal uptake, which is particularly well defined in sternoclavicular and manubriosternal joint regions, there are two areas of extraosseous ^{99m}Tc localization within lung fields. (B) Chest radiograph, taken 6 days after bone scan, shows well-defined tumors in lungs.

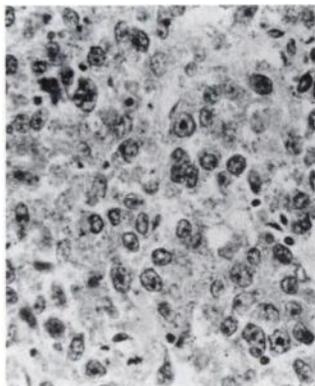


FIG. 2. Photomicrograph of metastatic seminoma from mediastinal lymph node.

ule, largely necrotic. The upper lobe of the left lung contained a firm gray tumor, 4 cm in diameter, which was centrally necrotic with a rim of viable tumor tissue. A separate tumor nodule, 1 cm in diameter, was found in the lingula. Both testes were small and on section appeared atrophic and with no sign of tumor. Histologic sections of the retroperitoneal tumor, lung tumors, abdominal and mediastinal nodes, and renal vein thrombus all showed typical seminoma. In all sites most of the tumor was necrotic, but small groups of viable cells confirmed the diagnosis. The testes showed severe degenerative changes of the tubules with interstitial fibrosis. No seminoma cells were seen in either testis. Sections of the lung tumors stained by von Kossa's method showed no calcification. The final pathologic diagnosis was extragenital retroperitoneal seminoma, involving the left kidney and lumbar spine, and metastatic seminoma involving the lungs and abdominal and mediastinal lymph nodes (8).

Although the ^{99m}Tc -labeled phosphates are excellent bone-scanning agents, it has become apparent that they are able to concentrate in tissues other than bone. In the present case the agent localized in lung metastases from an extragenital seminoma, although there was no preferential accumulation in soft-tissue tumor at other sites. Within the lung metastases the technetium distribution was nonuniform (Fig. 1A), with apparently less uptake in the central necrotic regions.

The mechanism of ^{99m}Tc -pyrophosphate accumulation remains obscure. Unreacted pertechnetate ions were not responsible, since no uptake by the thyroid or salivary glands were detected. There was no microscopic evidence of calcification within the lesions. A similar finding was reported by Lowenthal et al. (2), who described cases of ^{99m}Tc -polyphosphate uptake by squamous-cell carcinomas of the lung. Chaudhuri et al. (9) showed that both ^{99m}Tc -polyphosphate and ^{87}Sr were concentrated by a noncalcified soft-tissue metastasis from an adenocarcinoma of the rectum. It seems unlikely that these bone-scanning agents would be preferentially taken up by tumors in the absence of significantly increased concentrations of calcium or phosphate. Possibly there is a mechanism involving the intracellular accumulation of calcium and phosphate, like that proposed by Bonte et al. to explain the uptake of ^{99m}Tc -pyrophosphate in infarcted myocardium (3). In the case of ^{99m}Tc -diphosphonate accumulation in malignant pleural effusions (5), however, the radiopharmaceutical was almost exclusively extracellular.

More than one mechanism are probably involved in the soft-tissue concentration of the ^{99m}Tc -labeled phosphate ra-

diopharmaceuticals. The reason for the uptake in the present case remains unresolved.

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Bone Scan in Melorheostosis

Melorheostosis is an uncommon disorder of bone diagnosed primarily by its characteristic appearance on roentgenograms. We believe this is the first report of a bone scan performed on a patient with melorheostosis.

The patient was a 16-year-old white male with known melorheostotic involvement of his left femur since age 6. At age 7 an epiphyseodesis of the distal right femur was performed to equalize growth between the right leg and the congenitally shortened left leg. Approximately 5 months prior to our bone scan, he had been seen in an orthopedic outpatient clinic for complaints of left knee pain secondary to injury while playing in a neighborhood football game. At that time, roentgenograms of the left knee revealed no bone or joint abnormalities; however, roentgenograms of his left proximal femur and pelvis showed evidence of melorheostosis (Fig. 1). The patient was given symptomatic treatment and released. Three weeks prior to the scan he complained of increasing left knee pain and right-sided thigh pain. A bone scan was recommended to assess the localization and extent of his known osseous disease, and for detection of other bone disease that might not be visualized on conventional roentgenograms.