MYOCARDIAL LOCALIZATION OF ^{99m}Tc-PYROPHOSPHATE WITHOUT EVIDENCE OF ACUTE MYOCARDIAL INFARCTION

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Localization of ^{99m}Tc-pyrophosphate in the cardiac region during routine bone scanning for metastatic tumor is discussed in two cases. Clinical information as well as electrocardiographic and serum enzyme studies did not reveal any evidence of acute myocardial injury. The cause of myocardial localization of the radiopharmaceutical is not clear in these cases.

Technetium-99m-pyrophosphate is currently employed with increasing frequency as a suitable radiopharmaceutical for skeletal scintigraphy (*1–4*). During routine bone imaging, significant extraskeletal localization is usually seen only in the region of the urinary system (kidney, ureter, bladder) (*4*). Bonte, et al first demonstrated the localization of ^{99m}Tc-pyrophosphate in acute myocardial infarctions in animals and in human patients (*5,6*). The localization of ^{99m}Tc-pyrophosphate corresponded to the injured myocardium in all cases of documented myocardial infarction. Recently, benign and malignant breast lesions in females have demonstrated uptake of phosphate compounds (*7,8*). This report describes significant uptake of ^{99m}Tc-pyrophosphate in the cardiac region of two patients with no clinical or laboratory findings indicative of acute myocardial injury.

CASE EXAMPLES

Case 1. LB is an 88-year-old woman who had a left radical mastectomy for carcinoma of the breast 6 years before the current admission. Except for complaints of dyspnea on exertion, probably related to congestive heart failure, her history was unremarkable. Her chief complaint was generalized bone aching.

Physical examination revealed tenderness in the midthoracic vertebrae posteriorly. The liver edge was palpable and there was Grade I edema of the lower extremities. To evaluate possible metastatic involvement of the osseous system, bone scanning was performed with ^{99m}Tc-pyrophosphate. Areas of inappropriate uptake were observed in the skull, in the lower dorsal and upper lumbar spine, and in the left sacroiliac joint region. In addition, significant uptake was seen on multiple views in the region of the heart (Fig. 1). Electrocardiograms indicated nonspecific ST-T wave changes, which had been present on previous examinations. A chest x-ray film and results of a cardiac fluoroscopic examination were unremarkable. All pertinent laboratory values were within normal limits except LDH, which was 254 IU (normal, 125–193).

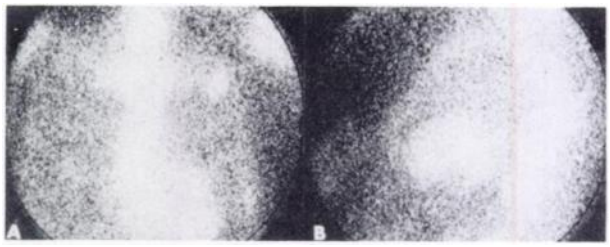

FIG. 1. Myocardial localization in patient (Case 1) who had left radical mastectomy for carcinoma of breast 6 years before current admission. Technetium-99m-(Sn)-pyrophosphate study: (A) anterior view; (B) left lateral view.

Case 2. A 60-year-old man with proven bronchogenic carcinoma of the left lung received 4,000 rads in 30 days with parallel-opposed fields to the involved area, approximately 1 year before the current admission. The patient had done well until recently when he began to cough up blood-streaked sputum.

Received Oct. 4, 1974; revision accepted April 29, 1975.

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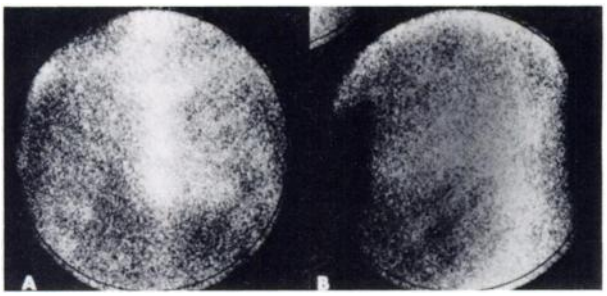

FIG. 2. Myocardial localization in patient (Case 2) with proven carcinoma of left lung who received 4,000 rads in 30 days with parallel opposed fields to involved area approximately 1 year before current admission. Technetium-99m-(Sn)-pyrophosphate study: (A) anterior view; (B) left lateral view.

There was no history suggestive of coronary artery disease. Except for healed skin burns on the anterior chest wall secondary to the radiotherapy, the findings of the physical examination were unremarkable. A bone scan was requested as part of the patient's metastatic workup. No areas of inappropriate radionuclide concentration were evident except in the region of the heart (Fig. 2). Pertinent laboratory values were within normal limits. The electrocardiogram revealed nonspecific ST-T wave changes.

DISCUSSION

Myocardial imaging using various radiopharmaceuticals promises to be a valuable and relatively simple means for distinguishing functional from infarcted tissue (*9–12*). The first agent to receive relatively widespread evaluation was ^{43}K which was being studied in patients with myocardial ischemia and in those with documented infarction. The presence of damaged or infarcted tissue is indicated by a decrease in concentration of ^{43}K, which causes a "cold" area on the resulting image. Potassium-43 has also been used to study the development of transient myocardial ischemia in subjects with exercise- or pacemaker-induced angina (*11*). Although this isotope is suitable for myocardial imaging, some of its features make it impractical for wide clinical application (*13*). Its chief disadvantages are cost, short shelf-life, and too high energy for the scintillation camera. In addition, it does not clearly separate recent from old ischemic myocardial injury (*13*).

The introduction of ^{99m}Tc-pyrophosphate has added a new dimension to myocardial imaging (*5*). This radiopharmaceutical not only possesses the suitable physical characteristics of ^{99m}Tc for the scintillation camera but also is selectively concentrated in acutely infarcted myocardial tissue. Detectable myocardial localization of ^{99m}Tc-pyrophosphate takes place as early as 12–16 hr after the vascular accident. The localization diminishes with time after the onset of the infarct and by 14 days accumulation of the radiopharmaceutical rarely occurs (*5*). The selective uptake of ^{99m}Tc-pyrophosphate is probably related to the phenomenon of intracellular calcium accumulation in irreversible myocardial injury, as described by Shen and Jennings (*14*). A similar phenomenon of increased uptake in infarcted myocardium has been demonstrated using ^{99m}Tc-labeled tetracycline (*12*).

The reason for localization of ^{99m}Tc-pyrophosphate in the cardiac regions of the two patients described in this report is not known. It is unlikely that it was related to the quality of the radiopharmaceutical because other bone scans obtained on the same days using the same preparation did not show cardiac accumulation. The question arises as to whether it is blood-pool activity, but there was no evidence of blood-pool accumulation elsewhere. Such activity would not be typical since the scans are obtained 2 or 3 hr after injection when the blood background is usually very low due to rapid skeletal uptake of the compound and concomitant renal excretion (*1*). It is also unlikely that the activity visualized in our patients is extracardiac, such as in breast or chest wall disease, because the multiple image projections would localize extracardiac activity. In addition, there was no laboratory or clinical evidence of acute myocardial infarction. The presence of infiltrative myocardial disease or pericarditis or both should be considered in these two patients because of the history of malignancy. Without further evidence, however, this is highly speculative. It appears from these studies that cardiac accumulation of pyrophosphate may occur in conditions other than acute myocardial infarction.

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