Annals of Nuclear Medicine Vol. 2, No. 2, 85–88, 1988

Technetium-99m pyrophosphate tomogram of nontransmural myocardial infarction: a case report

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Single-photon emission computed tomography (SPECT) with ^{99m}Tc-pyrophosphate (^{99m}Tc-PYP) has been reported to be useful in the detection and localization of acute nontransmural infarctions. Localized uptake of ^{99m}Tc-PYP has been shown in patients with nontransmural infarction in these studies. It is likely, however, that anatomically transmural infarctions could be mislabelled as nontransmural infarctions, since the absence of new abnormal Q waves has been used in differentiating between nontransmural and transmural infarctions. We report a case of relatively diffuse nontransmural infarction demonstrated by a semicircle of ^{99m}Tc-PYP activity which significantly overlapped ^{201}Tl uptake on the SPECT study.

Key words: Nontransmural myocardial infarction, SPECT, Tc-99m pyrophosphate

INTRODUCTION

THE DIAGNOSIS of nontransmural or subendocardial myocardial infarctions is difficult to confirm since the accompanying electrocardiographic changes are nonspecific. Nontransmural infarctions have been diagnosed from the clinical history, typical increase in serum cardiac enzymes, and ST-T changes without new abnormal Q waves. Infarct-avid scintigraphy has been expected to prove to be a new method to use in directly identifying the presence and the location of myocardial infarctions without abnormal Q waves. Although early reports suggested that myocardial scintigraphy with ^{99m}Tc-pyrophosphate (^{99m}Tc-PYP) is a sensitive test for detecting nontransmural infarctions,[1,2] subsequent studies demonstrated a substantially lower accuracy of planar imagings with ^{99m}Tc-PYP in patients with nontransmural infarction.[3,4]

Recent studies have shown that single-photon emission computed tomography (SPECT) with ^{99m}Tc-PYP provides more accurate detection and localization of relatively small infarcts than with planar imaging.[5,6] Most reports have shown tomograms with localized uptake of ^{99m}Tc-PYP in patients with acute myocardial infarction without abnormal Q waves. We present a case of relatively diffuse nontransmural infarction demonstrated by the SPECT study with ^{99m}Tc-PYP.

Received December 7, 1987, revision accepted March 24, 1988.

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CASE REPORT

A 73-year-old male was admitted to our hospital with dyspnea and chest pain. On admission, he was diagnosed as having acute left-sided heart failure, together with mild aortic regurgitation and severe anemia. Although the serial electrocardiograms demonstrated no signs of acute myocardial infarction (AMI) other than marked ST depressions in leads I, II, III, aVF and V_{4-6} (Fig. 1), AMI was suspected because of a significant increase in serum cardiac enzymes (peak CPK: 794 IU/*l*, peak GOT: 152 K.A.U.). Myocardial scintigraphy with ^{99m}Tc-PYP was performed to confirm and localize AMI.

Planar images obtained 4 hours after the injection of 20 mCi of ^{99m}Tc-PYP demonstrated a diffuse cardiac uptake of radioactivity (Fig. 2). A SPECT study performed immediately after the acquisition of

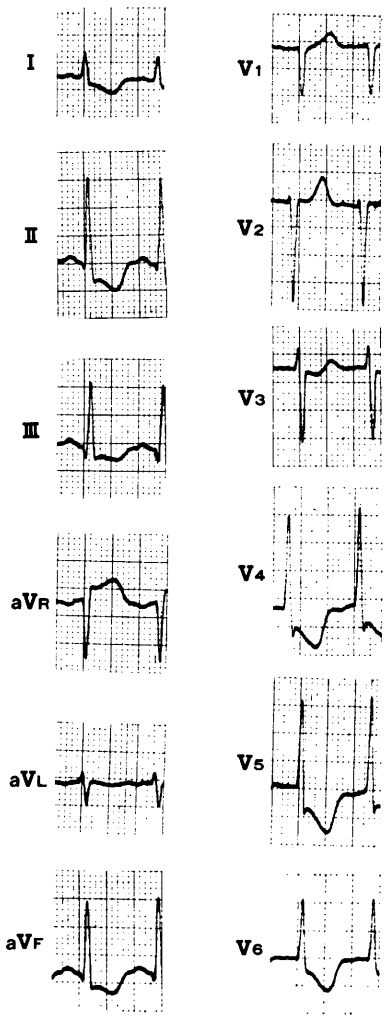

Fig. 1 Electrocardiogram obtained on admission showing marked ST depressions in leads I, II, III, aVF and V_{4-6} (1 mV=10 mm in the limb leads, 1 mV=5 mm in the precordial leads).

planar images revealed a semicircle of activity in the form of a large rim with a clear central zone (Fig. 3A), which excluded the possibility of persistent blood pool activity. SPECT with ^{201}Tl carried out 3 days after the above studies revealed a small perfusion defect in the apex (Fig. 3B). There was a significant overlap of ^{99m}Tc-PYP and ^{201}Tl activity on the tomograms. These SPECT studies were obtained on a standard field-of-view rotating gamma camera (ZLC 7500, Siemens) interfaced to a dedicated minicomputer system (Scintipac 2400, Shimadzu) and 32 images (64×64 pixels, 20 sec/frame) were collected during 180-degree rotation from right anterior oblique to left posterior oblique. A relatively diffuse nontransmural infarction with a small transmural infarction of the apex was diagnosed from these findings.

Subsequent coronary angiography demonstrated significant stenoses of the proximal left anterior descending artery, high lateral branch, posterolateral branch and distal right coronary artery. Left ventriculography revealed hypokinesis of the septal and anterolateral segments and severe hypokinesis of the apical segment.

DISCUSSION

Several reports have shown that SPECT with ^{99m}Tc-PYP was a useful diagnostic test in patients with nontransmural infarction. Most reports have shown focal uptakes in tomographic images.[5–8] As far as we know, there have been no reports which showed a semicircle of activity, such as in this case, on the SPECT study in patients with nontransmural infarction.

The focal uptake of radioactivity could represent localized transmural infarcts without abnormal Q waves rather than anatomically nontransmural infarcts, since abnormal Q waves have been reported to be unable to differentiate between transmural and nontransmural infarcts anatomically.[9] In previous studies on the effectiveness of infarct-avid scintigraphy, indeed, nontransmural or subendocardial infarctions have been diagnosed from ST-T abnormalities without abnormal Q waves,[1–8] and anatomically transmural infarctions could be mislabelled as subendocardial or nontransmural infarctions.

We have presented a case in which SPECT with ^{99m}Tc-PYP revealed a relatively diffuse uptake of radioactivity. The region of ^{99m}Tc-PYP uptake was definitely larger than the ^{201}Tl defect, and there was significant overlapping of ^{201}Tl and ^{99m}Tc-PYP activity. There are several possible explanations for the overlap.

First of all, ^{99m}Tc-PYP accumulation could be mainly subendocardial in areas of nontransmural infarcts, while ^{201}Tl could be present in the overlapping epicardial tissues.[10,11] In experimental animals, Prigent et al.[12] observed that subendocardial infarction involving less than 50% of the myocardial wall thickness was either missed or underestimated by ^{201}Tl tomography. Schofer et al.[13] demonstrated a significant overlap of ^{201}Tl uptake and ^{99m}Tc-PYP accumulation after thrombolysis in some patients with AMI and suggested that the overlap reflects the close proximity of viable and necrotic myocardial cells. It is likely that a significant overlap of ^{201}Tl and ^{99m}Tc-PYP activity on the tomogram could indicate acute nontransmural infarction. In keeping with this interpretation, we diagnosed nontransmural infarction in this case.

Another possible explanation is that there may be ^{99m}Tc-PYP uptake in reversibly damaged cells, which may accumulate ^{201}Tl later on as in this case (3 days

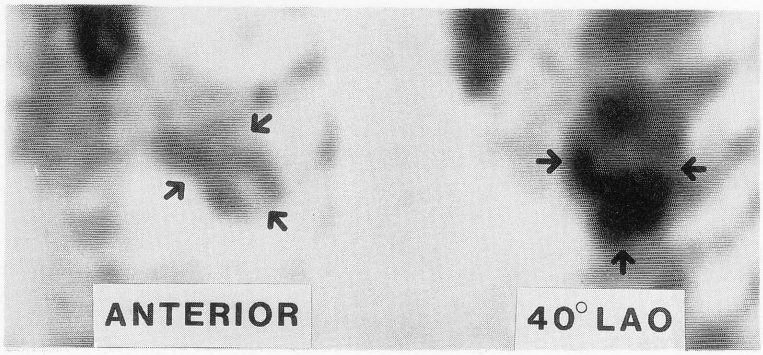

Fig. 2 Planar ^{99m}Tc-PYP scintigrams showing a diffuse cardiac uptake (arrows).

Fig. 3 A: Transaxial tomogram with ^{99m}Tc-PYP showing a semicircle of activity (arrows). B: Corresponding transaxial tomogram with ^{201}Tl showing a small perfusion defect in the apex (arrow). Note the significant overlap of ^{99m}Tc-PYP and ^{201}Tl activity.

later). A defect demonstrated by ^{201}Tl imaging, however, was thought to be too small to explain the significant increase in serum cardiac enzymes in this case.

In addition, the current resolution of available instruments and patient movement may limit the precise localization of ^{99m}Tc-PYP and ^{201}Tl activity and the accurate comparison of ^{99m}Tc-PYP and ^{201}Tl images. Although we have not used it in this case, simultaneous dual-isotope SPECT with ^{99m}Tc-PYP and ^{201}Tl could provide a more accurate comparison of the two images.[14]

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