Myocardial Scans and Wall Motion Studies Using Tc-99m Pyrophosphate in Suspected Acute Myocardial Infarctions

Kathryn Wilkins and Lionel Reese

St. Joseph's Hospital and University of Western Ontario, London, Ontario, Canada

Two different radionuclide procedures were performed on 53 patients to validate a clinical diagnosis of acute myocardial infarction (AMI). A bolus of Tc-99m pyrophosphate was injected, and on the first pass of this bolus through the heart, left ventricular wall motion studies were performed. This was followed by myocardial scintigraphy. A second wall motion study in another projection was performed after a second bolus injection. Data suggest that the combination of the scintigram and wall motion study was significantly valuable in determining the patients' diagnoses.

Patients with acute myocardial infarction (AMI) continue to provide a diagnostic challenge to the clinician—even with present diagnostic methods, an AMI often remains difficult to confirm (*1,2*). In our department, first pass wall motion studies were carried out on all patients referred for myocardial scintigraphy. Our objective was to determine the value of wall motion studies in this patient population.

Materials and Methods

Fifty-three patients with suspected recent AMI were brought to our nuclear medicine department under appropriate supervision. Their ages ranged from 46 to 78 years and they included 42 men and 11 women. The wall motion studies were performed using a Cordis-Baird computerized multicrystal camera, System Seventy-Seven® (Cordis-Baird, Bedford, MA), with the 1-in. lead collimator. Each patient was positioned under the detector in a 20° left anterior oblique (LAO) projection and 15 mCi of Tc-99m pyrophosphate was injected as a bolus, followed by 20 ml of saline. Precordial activity was recorded as 1,000 50-msec frames.

Myocardial scintigrams to an information density (I.D.) of 3,000 were obtained 1½ hr after injection using a Picker Dyna Camera 4/15 (Picker Corp., North Haven, CT). Images were obtained in the anterior, LAO, right anterior oblique (RAO), and left lateral projections.

After completion of the myocardial scintigraphy, another first pass study was performed on the Cordis-Baird with the 1½-in. lead collimator. This time a 25° RAO projection was used. Twenty-five mCi of Tc-99m gluconate, which is rapidly cleared by the kidneys, was injected as a bolus. Currently, a CMA bilateral collimator, which allows simultaneous recording of the LAO and RAO projections, is used in our department, thus elimimating the need for a second injection.

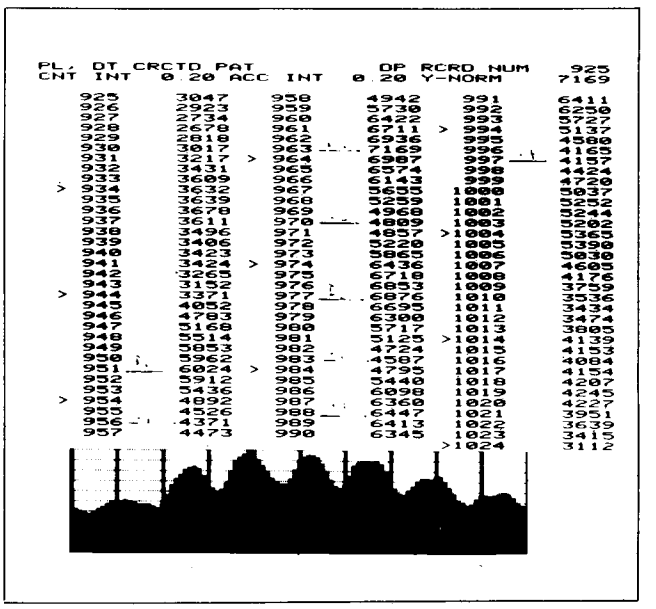


FIG. 1. Time-activity curve represents left ventricular activity, where the peaks represent diastole and the troughs represent systole; an average of four diastolic peaks and systolic troughs are summed to create end-diastolic and end-systolic images.

For reprints contact: Kathryn Wilkins, Dept. of Nuclear Medicine, St. Joseph's Hospital, 268 Grosvenor St., London, Ontario, Canada N6A 4V2.

Data Analysis

First pass data were corrected for uniformity, room background, and deadtime. The area of the left ventricle was flagged and a subsequent histogram was produced showing the peaks identifying end-diastole (ED) and the troughs identifying end-systole (ES) (Fig. 1). Representative images of ED and ES were produced by computer-summing an average of four diastolic peaks and four systolic troughs. The ED and ES images were corrected for patient background, as has been previously reported (*3,4*).

The image of ES was substracted from the image of ED to produce a stroke volume (SV) image, which was then divided by the ED image to produce a regional ejection fraction image (REFI). The REFI represents regional changes in volume that occur during systole. Perimeters were also produced for the ED and ES images and these were superimposed.

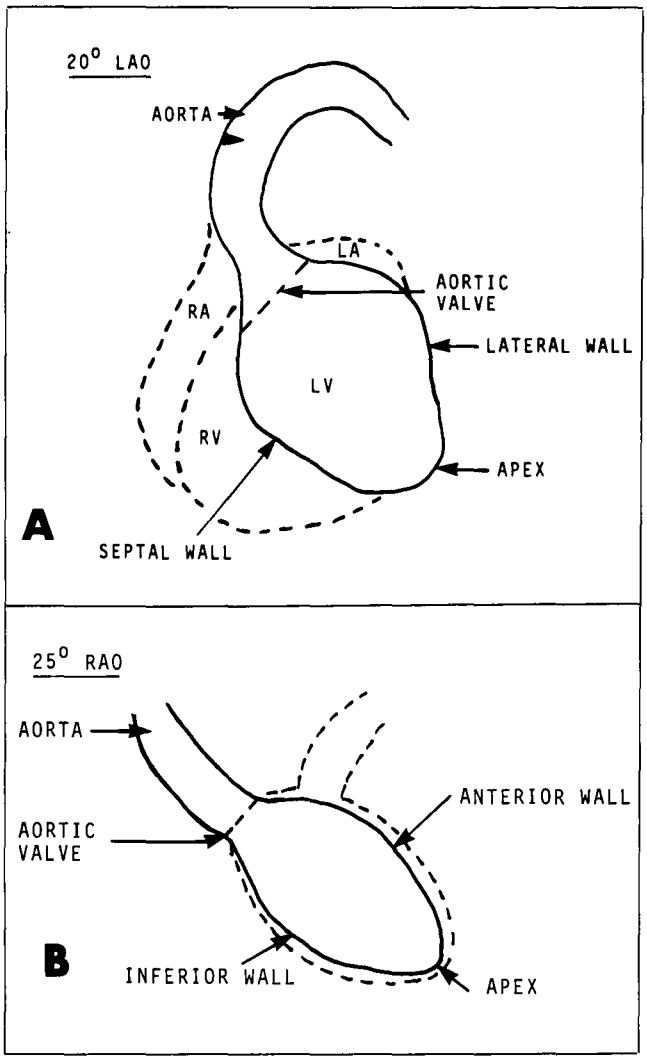


FIG. 2. The left ventricle as seen in the 20° LAO position (A). The solid lines indicate the heart chambers identifiable in this radionuclide procedure; their relationship to other cardiac chambers is indicated by the dotted line. This projection demonstrates the wall motion of the lateral wall, septal wall, and apex. The left ventricle in the 25° RAO projection (B) shows wall motion of the anterior wall, inferior wall, and apex.

In the LAO projection we were able to see images associated with wall motion of the lateral wall, septal wall, and apex (Fig. 2A). In the RAO projection, the images seen were associated with wall motion of the inferior and anterior walls as well as the apex (Fig. 2B).

Figure 3 shows a normal wall motion study in the LAO projection. The regional ejection fraction image (Fig. 3A) shows a homogeneous band of motion on all three walls, as does the superimposition of ED and ES perimeters shown in Fig. 3B (e.g., uniform separation of the perimeters). Figure 3C shows a normal REFI in the RAO projection; this again shows a homogeneous band of motion on all three walls.

Results

The wall motion scintigraphy results on the 53 patients (Table 1) were compared to electrocardiogram (ECG) and enzyme results obtained from the patients' charts. The patients have been classified according to three categories.

TABLE 1. Summary of Results of Wall Motion Scintigraphy Performed on 53 Patients

	Clinical Diagnosis	Positive Scan	Abnormal Wall Motion
Normal	10	0	0
Acute Myocardial Infarctions	20	15	20
Coronary Heart Disease	23	1	23

Group I consisted of 10 patients who proved to be clinically negative for AMI. All ten of these patients had normal myocardial scans and normal wall motion studies.

Group 2 consisted of 20 patients who proved to have had an AMI. Five of these patients had negative myocardial scans, but showed wall motion abnormalities which corresponded well with suspicious regions localized by ECG (Fig. 4).

Group 3 consisted of 23 patients who were thought to be negative for AMI, but who proved to have some type of coronary heart disease. All but one of these patients had a negative scan, but all had regions of abnormal wall motion.

Conclusion

We found that:

1. A normal myocardial scan and a normal wall motion study definitely ruled out an AMI.
2. A positive myocardial scan accompanied by a wall motion abnormality in the same region confirmed an AMI.

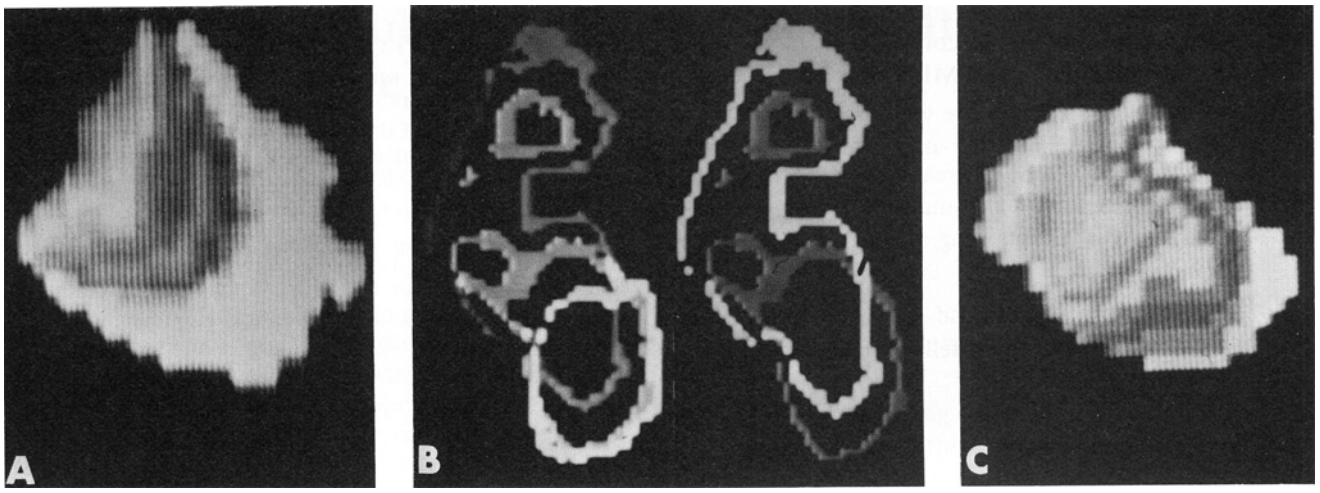


FIG. 3. Normal wall motion: REFI in the LAO projection (A); superimposition of ED and ES perimeters in the LAO projection (B); and REFI in the RAO projection (C).

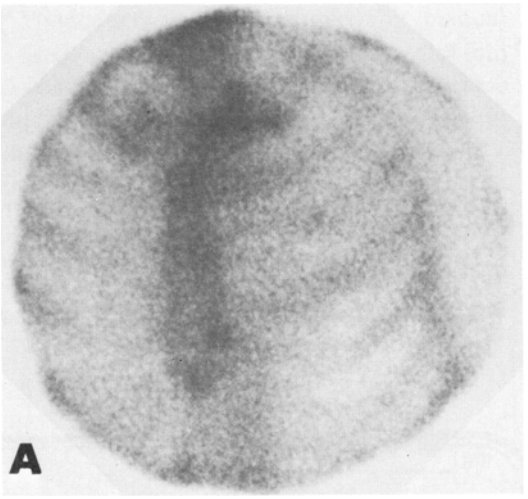
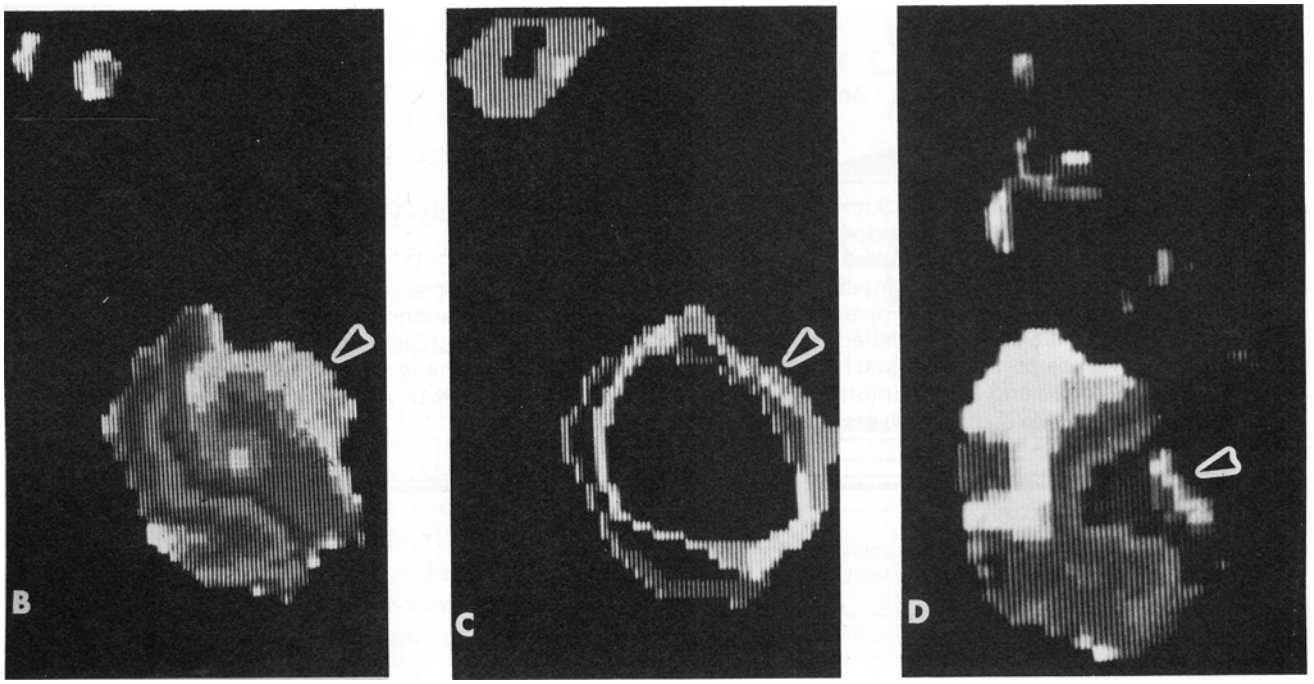


FIG. 4. Anterior myocardial scintigram reported as normal (A). The REFI in the LAO projection shows an akinetic lateral wall and apex (arrow) (B). Also shown by the superimposition of ED and ES perimeters (arrow) (C). The REFI in the RAO projection showed an akinetic anterior wall (arrow) (D).



3. A normal myocardial scan and an abnormal wall motion study are suggestive of coronary heart disease, but can still be indicative of an AMI.

In conclusion, even though the wall motion study itself cannot differentiate between an old or an acute infarction, it has proven to be of great value. It also gives the clinician an overview of the amount of physiologically viable myocardium remaining.

Acknowledgment

We would like to thank our fellow staff members.

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