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• Heart
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Improved detection of healed myocardial infarction by Fourier amplitude and phase imaging in two projections: Validation with MRI

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Abstract: Biplane Fourier amplitude and phase images from radionuclide ventriculograms were analyzed for the presence of regional wall motion abnormalities in 25 patients who had a total of 33 healed myocardial infarctions (nonviable scar tissue) documented by contrast ventriculography and ECG. This indirect evidence was validated by MRI, which permits direct visualization of healed myocardial infarction. The use of amplitude and phase images in both projections resulted in the detection of more healed myocardial infarctions (91%) than did the use of conventional radionuclide ventriculography with left anterior oblique images alone (67%), because inferior wall infarcts are more readily visualized in the left posterior oblique projection.

Introduction

Fourier analysis of the radionuclide ventriculogram separates the image data of the beating heart into discrete frequencies. Of these frequencies, the first harmonic corresponds closely to the cardiac cycle. First harmonic amplitude images reflect regional stroke volume, while first harmonic phase images reflect regional sequential ventricular activation. Thus, regional contraction and coordination of wall motion may be evaluated with only one algorithm. For this reason, static first harmonic amplitude and phase images, resulting from Fourier analysis of the radionuclide ventriculogram, have proved to be very useful for the detection, evaluation and followup of left ventricular regional wall motion abnormalities in coronary artery disease *(1–3)*. Healed myocardial infarction (MI), with wall thinning resulting from scar formation, can be localized by observation of the Fourier analysis first harmonic as a region of

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Introduction

decreased amplitude and delayed activation (phase) in resting radionuclide ventriculogram images. Ischemic but viable myocardial tissue can be identified as a region which is usually normal at rest, but which exhibits both decreased amplitude and delayed activation at peak exercise *(4)*. The first harmonic static images of the Fourier amplitude and phase image analysis have been shown to increase the sensitivity of detection of healed MI significantly, when compared with visual wall motion analysis alone *(5)*. Nearly all previous studies have employed only a single projection—the standard left anterior oblique (LAO)—for amplitude and phase image analysis of regional wall motion abnormalities. This study reports our experience using Fourier analysis of the radionuclide ventriculogram in two projections, the LAO and a left posterior oblique (LPO).

In this report we demonstrate the value of biplane Fourier analysis for the diagnosis of healed MI (nonviable scar tissue). The documentation of nonviable scar tissue was made by contrast ventriculography and ECG as the "gold standard." This indirect evidence was validated by magnetic resonance imaging (MRI), which permits direct visualization of a healed MI as a localized region of wall thinning.

Methods

PATIENT POPULATION

The study group comprised 27 male patients (mean age 59, range 38–82) with known or suspected left ventricular dysfunction. They underwent radionuclide ventriculography to establish their left ventricular ejection fractions as a criterion for entry into the national cooperative study of left ventricular dysfunction. Twenty-five of these patients with a clinical history of one or more MIs documented by appropriate enzyme and ECG changes had a total of 33 healed MIs. Of the 33 healed MIs in these 25 patients, 21 infarcts in 17 patients were identified and localized by regional wall movement abnormalities on contrast ventriculography and by angiographic evidence of coronary artery disease in the involved coronary territory. Twelve infarcts in the remaining 8 patients were documented by Q waves on the ECG. The healed infarcts were in the distribution of the left anterior descending, 15, the right coronary, 15, and the left circumflex, 3, arteries. Eight patients, of the study group of 27, had had 2 MIs, 17 had had 1 MI and 2 were free of MI.

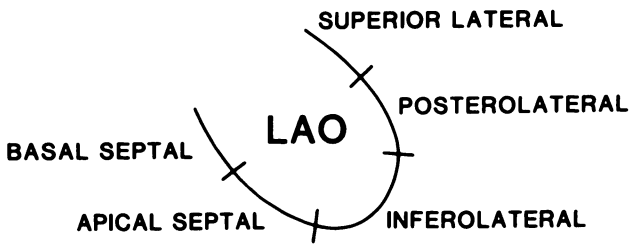
IMAGING PROCEDURE

After in vivo red blood cell labeling with 20 mCi of $^{99m}TcO_4$, ECG gated images of the supine patient at rest were obtained with a Picker Dynacamera™ 411[1] equipped with a low energy, all purpose collimator. The camera was interfaced to an ADAC[2] system IV-A computer, using software version IV-C. Each patient was imaged using a 5–10° caudal tilt of the scintillation camera in a modified LAO view with the angulation adjusted for optimal ventricular separation. After acquisition of the LAO image, the patient was rotated 90° to his right, so that he was lying on his right side. This orientation allowed data acquisition in the LPO projection without moving the camera. For each view, 16 frames were acquired over the cardiac cycle, using a 64 X 64 matrix and a ±10% beat rejection window. Data were acquired until one pixel reached the maximum count of 255, resulting in approximately 500,000 counts per view in about 10 minutes.

To determine the left ventricular ejection fraction, a region of interest was manually drawn over the left ventricle in the LAO view, and a time vs activity curve was plotted from the 16 frames. Background activity, determined from a region of interest chosen to avoid the spleen, was subtracted from the image data before calculation of the left ventricular ejection fraction. Two experienced technologists obtained such an ejection fraction on each patient, and the mean value was

[1] Picker International, Highland Heights, OH
[2] ADAC Laboratories, Milpitas, CA

recorded. The mean interobserver difference was 2.4% ± 1.7% (range 0–6%). The LAO and LPO images were each divided into five segments (Figure 1). Wall motion abnormalities were assessed blindly from the cine display of LAO and LPO views by two experienced physicians. Only regional dysfunction noted in the same area by both observers was considered indicative of a regional wall motion abnormality.



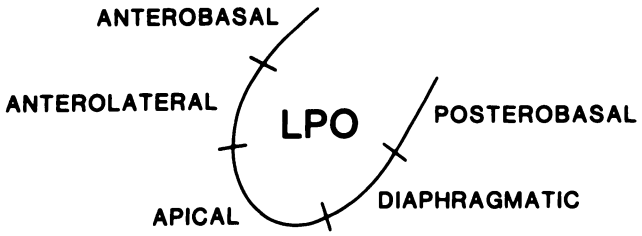


Figure 1
Segments analyzed in the LAO and LPO views

DATA ANALYSIS

Fourier analysis of spatially smoothed images was performed on a pixel by pixel basis. Only the first harmonic of the amplitude and phase for each pixel was determined, resulting in an amplitude image and a phase image. In the amplitude image, the amplitude of the first harmonic for each pixel was scaled to the maximum amplitude for all pixels and encoded in one of 16 color levels, so that each level represented a range of values equal to 6.25% of the maximum (100% ÷ 16 color levels = 6.25%/color level). The color of each pixel was, therefore, related to the change in blood volume associated with that pixel. In the phase image, the calculated phase of the first harmonic for each pixel was encoded in one of 16 color levels, with each level corresponding to a 22.5° increment over the cyclic range from 0° to 360° (Figure 2). Therefore, the phase angle for each pixel corresponded to one of the 16 time increments in the R-R interval, representing the relative time during the cardiac cycle at which the pixel acquired its maximum count rate. The criteria of Alcan et al. (6) were used to determine the presence of localized dysfunction and to assess the severity of regional wall motion abnormalities from the amplitude and phase images (Table I). Amplitude and phase images were interpreted by two independent observers who were given no information concerning the patients' histories and clinical data. Only regional wall movement abnormalities noted in the same area by both observers were considered indicative of infarction.

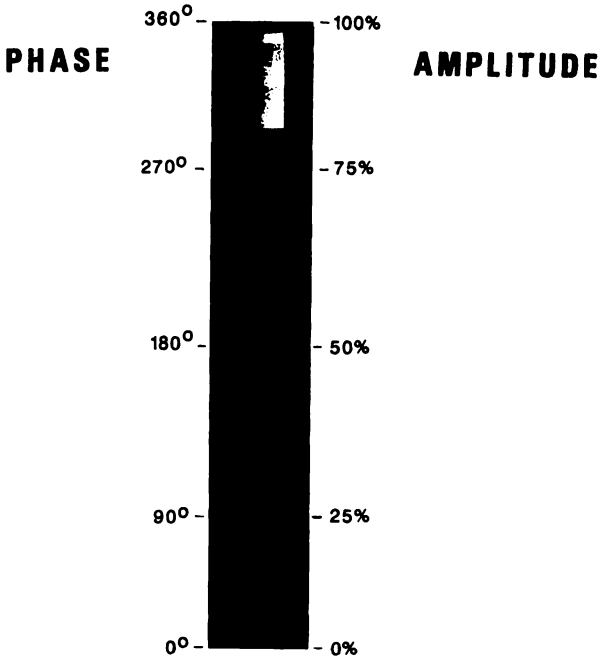


Figure 2
Color scale of 16 levels used for grading of abnormalities The amplitude image is scaled to the maximum intensity, with each color level representing 6.25% of maximum. Each color level on phase analysis represents a phase change of 22.5°.

TABLE I
CRITERIA FOR FOURIER AMPLITUDE AND PHASE ANALYSIS*

Amplitude image	
Scale	0–100% (1–16 levels; 1 level = 6.25%)
Normal	50–100% of maximum amplitude (top 8 levels)
Hypokinesis	25–50% of maximum amplitude (next 4 levels)
Akinesis	0–25% of maximum amplitude (last 4 levels)
No amplitude	0 (represented by black pixels)
Phase image	
Scale	0–360° (1–16 levels; 1 level = 22.5°)
Normal	≤45° (2 levels)
Asynergy	≥45° ≤ 112.5° (2–5 levels)
Dysynergy	>112.5 (>5 levels)
No phase	0 (represented by black pixels)

* From Alcan et al. (6).

MAGNETIC RESONANCE IMAGING

Conventional, ECG gated, spin echo pulse sequence images were obtained at a field strength of 0.15 T. In all subjects, MR images were generated in modified planes relating to the left ventricular axes as described elsewhere *(7–9)*. Healed myocardial infarction resulting in scar formation can be detected as a region of wall thinning by MRI. Unless wall thinning is extreme, end diastolic images are theoretically preferable to end systolic images for the demonstration of loss of myocardium. This is true because a decrease in systolic wall thickness may be relative, as a result of ischemia, rather than absolute, as a result of scar formation. Unfortunately, the slow flow of blood at end diastole frequently results in a signal the intensity of which is such that the internal myocardial wall is obscured. For this reason, abnormal segments were identified on end systolic images as regions of decreased wall thickness in which the thickness of a wall region was less than 50% of the adjacent, normal appearing region *(7)*. The MR image analysis was performed prospectively by one observer who was unaware of any other information about the patient. The abnormal regions were anatomically localized to correspond to the same myocardial segments as in radionuclide ventriculography.

Results

THE NORMAL AMPLITUDE AND PHASE IMAGE

Normal amplitude and phase images using the color scale recommended by Pavel *(4)* are shown in Figure 3. LAO amplitude images reveal the left ventricle as an oval region of white color, corresponding to the greatest change in count rate (maximum amplitude), with the right ventricle and atria having lower amplitudes. Normal LAO phase images show both ventricles to have simultaneous and uniform activation. The atria are 180° out of phase with respect to the ventricles, representing atrial filling during ventricular contraction. On both LAO amplitude and phase images, the plane of the mitral valve is easily discernible. In the LPO amplitude image, the left ventricle is seen as an oval region of the highest intensity white color; this appearance is very similar to that of the left ventricle as seen in right anterior oblique contrast ventriculography. In the LPO phase image, the left atrium and the left ventricle are seen in opposite phases of activation. The plane of the mitral valve is clearly seen in both LPO amplitude and phase images.

Results

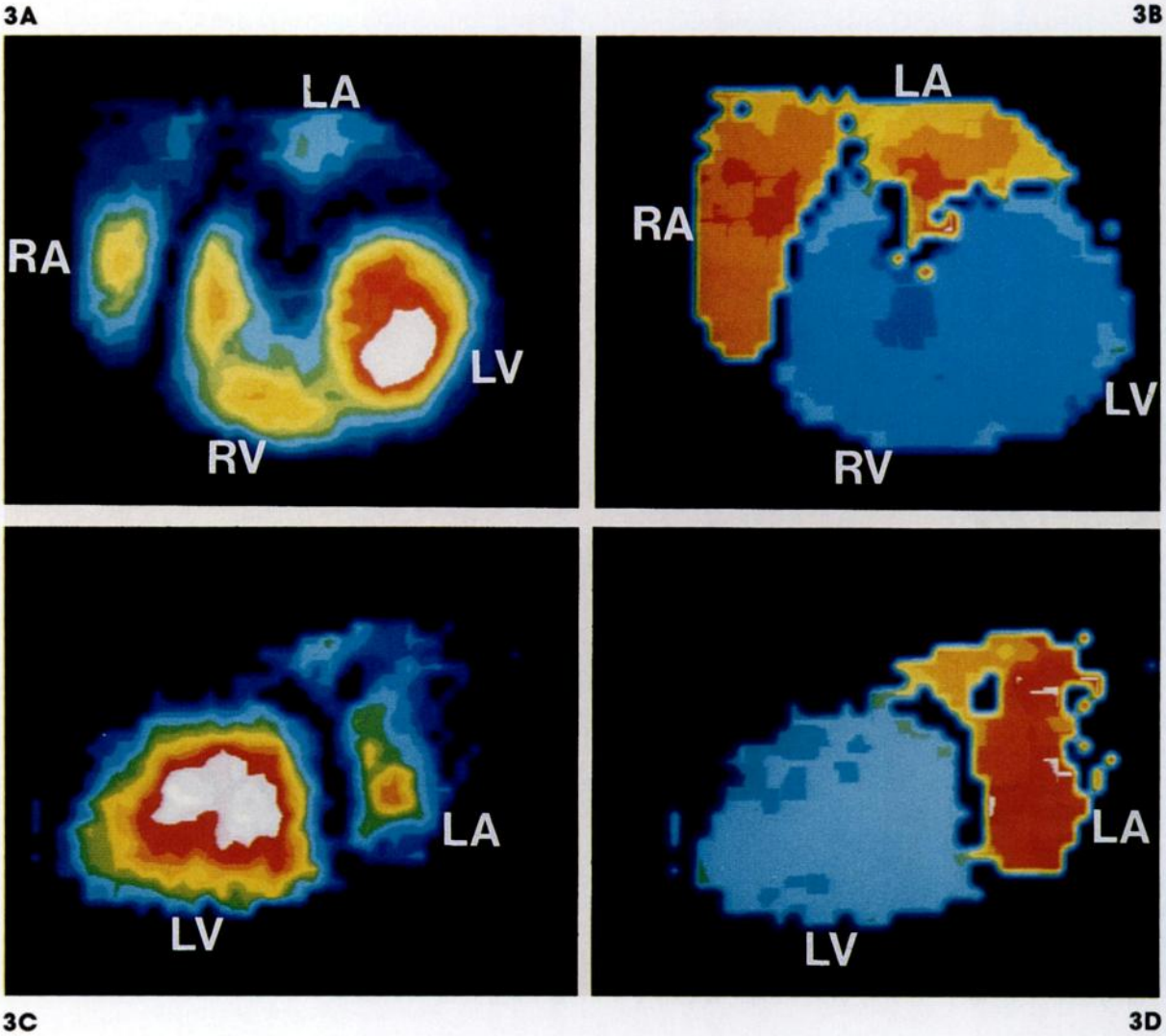
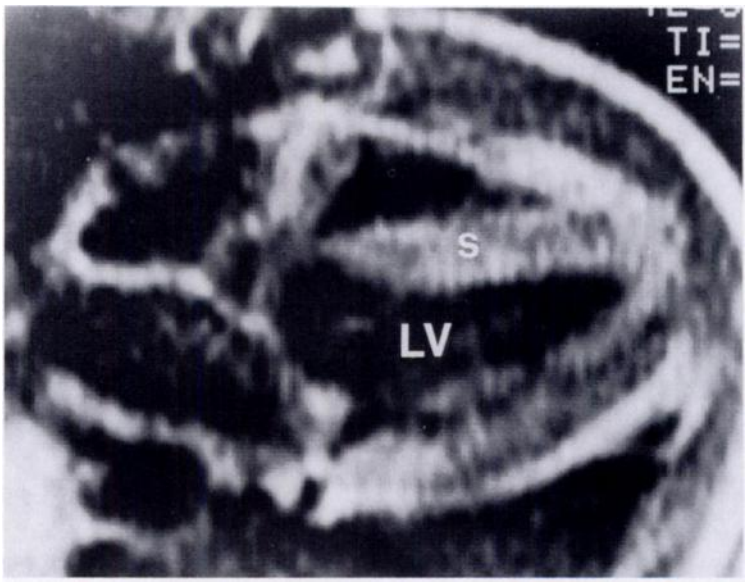


Figure 3
Fourier and MR images of the normal heart (A) LAO amplitude image The high amplitude regional stroke volume of the left ventricle, LV, is depicted as an oval region of high color intensity, white, that is symmetric around the LV contour. The right ventricle, RV, has approximately one-half the amplitude, orange, of the LV, and the atria have lower amplitude colors. (B) LAO phase image Both ventricles represented as dark blue have simultaneous and uniform activation which is 180° out of phase with the atria represented in orange, reflecting the sequence of cardiac electrical depolarization. (C) LPO amplitude image This projection allows the left ventricle, LV, to be seen in profile, demonstrating uniform high amplitude within its contours. It is clearly separated from the left atrium, LA, by the plane of the mitral valve. (D) LPO phase image There is uniform activation of the left ventricle, LV, which is 180° out of phase with the left atrium, LA. This view is similar in projection to the RAO contrast ventriculogram. (E) Horizontal long axis MR image There is symmetric uniform thickness of the septum, S, and posterior left ventricular wall, LV, in end systole.



3E

THE ABNORMAL AMPLITUDE AND PHASE IMAGE IN HEALED MYOCARDIAL INFARCTION

An isolated anterior or anteroseptal MI resulting from an occlusion of the left anterior descending artery is characteristically recognized as a band of decreased amplitude and delayed activation of the septum and anterior wall on the LAO images (Figure 4). On the LPO view, the anterior wall is shown in relation to the long axis of the left ventricle. It has diminished amplitude and delayed activation relative to the normal, while the inferior wall has a normal amplitude and activation pattern.

Results

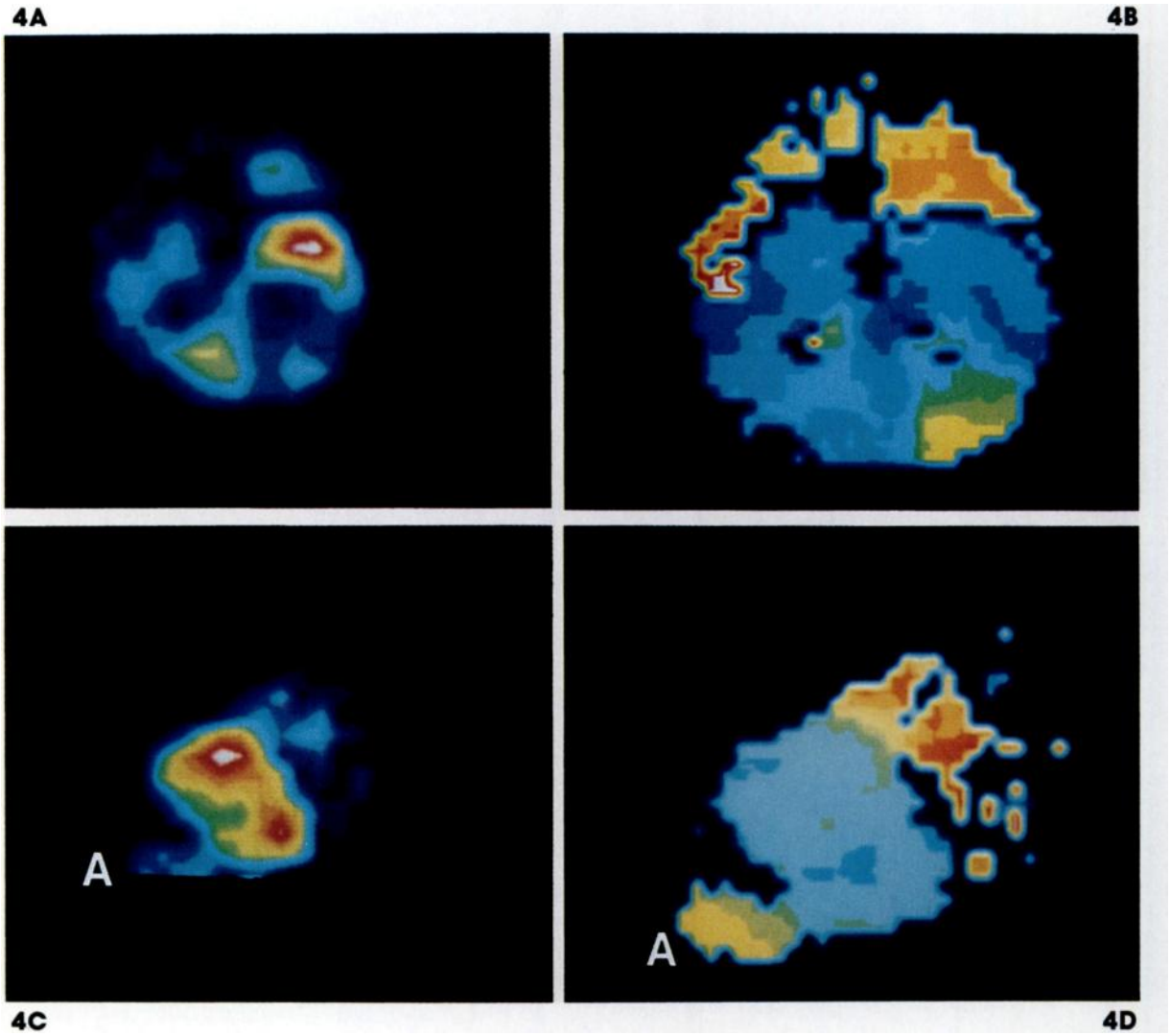
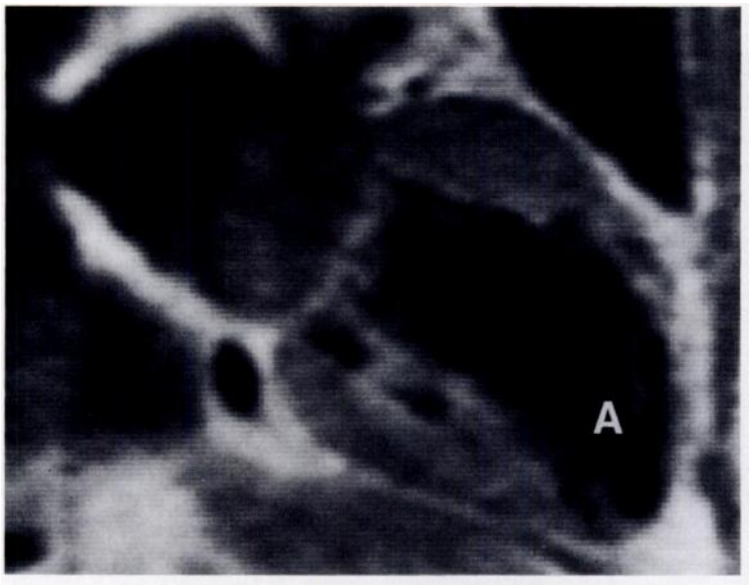


Figure 4
Fourier and MRI images of anterior myocardial infarct (A) LAO amplitude image There is an area of absent amplitude (black pixels) in the center of the left ventricle surrounded by a region of markedly diminished amplitude (blue pixels) involving the basal septal, apical septal and inferolateral segments. The base of the heart, including the superior lateral and posterolateral segments, has normal amplitude. (B) LAO phase image There are two small regions of no activation (black pixels) in the center of the left ventricle, corresponding to the somewhat larger area of zero amplitude in the LAO amplitude image. From this area of no activation, there are regions of increasingly delayed activation (green and yellow pixels), extending to the apical septal and inferolateral segments. (C) LPO amplitude image This projection clearly localizes the abnormality seen on the LAO amplitude image to the anterolateral (black pixels), apical, A, and diaphragmatic (blue pixels) segments. The anterobasal and posterobasal segments have normal amplitude. (D) LPO phase image This image demonstrates no activation (black pixels) of the anterolateral segment and markedly delayed activation of the apical and diaphragmatic (yellow pixels) segments, while the anterobasal and posterobasal segments are activated in normal sequence. (E) Vertical long axis MR image An end systolic image shows anteroapical wall thinning, A. The patient had an anteroapical infarction owing to the occlusion of the left anterior descending artery.



4E

An isolated, inferior wall myocardial infarct is usually due to occlusion of the right coronary artery but may be caused by left circumflex artery occlusion in the presence of left coronary artery dominance. Inferior infarctions are often not seen at all in the LAO amplitude and phase images but, when large, can appear as regions of delayed activation of the inferolateral segment. This problem is easily resolved using LPO amplitude and phase images which correctly localize areas of dysfunction to the posterobasal or diaphragmatic segments (Figure 5). Infarctions resulting from left circumflex artery occlusion may be anterolateral (obtuse marginal branch), posterolateral (distal circumflex), or inferior when there is left dominance.

Results

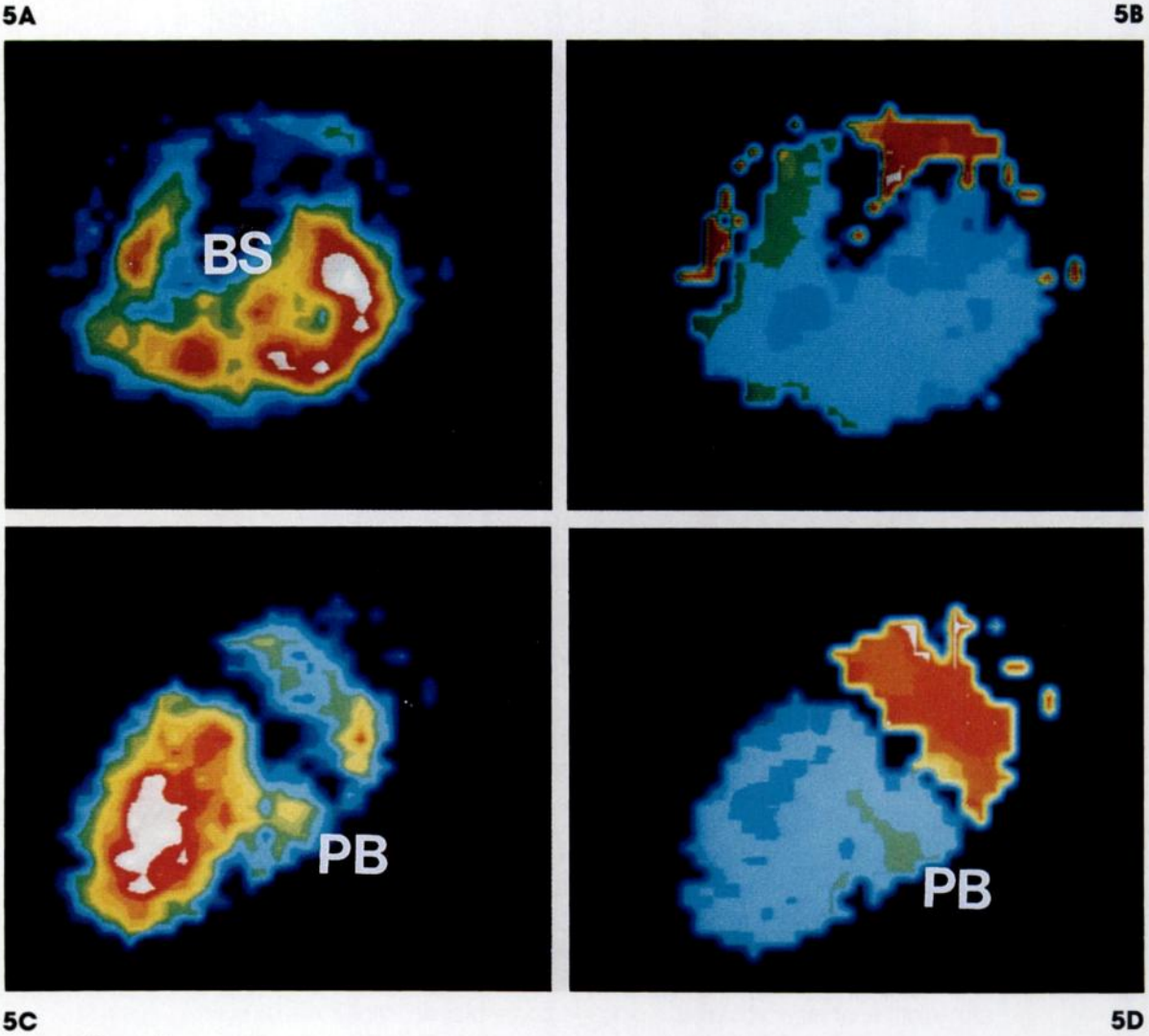
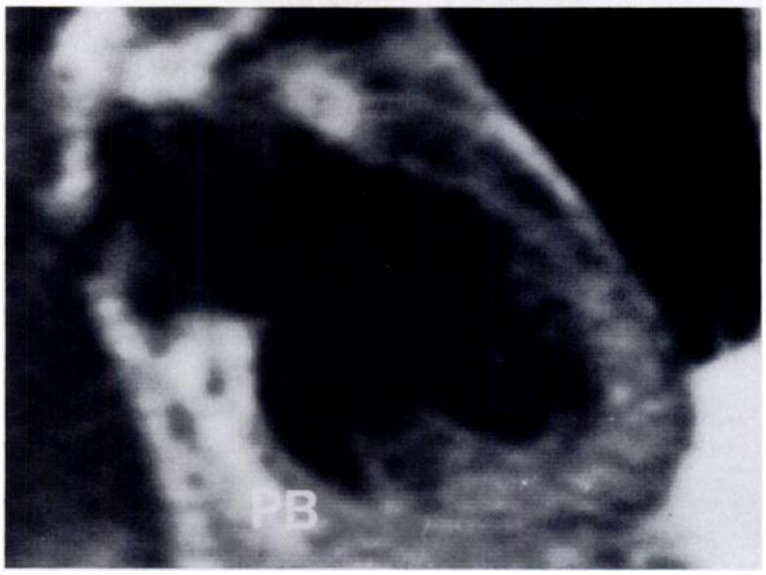
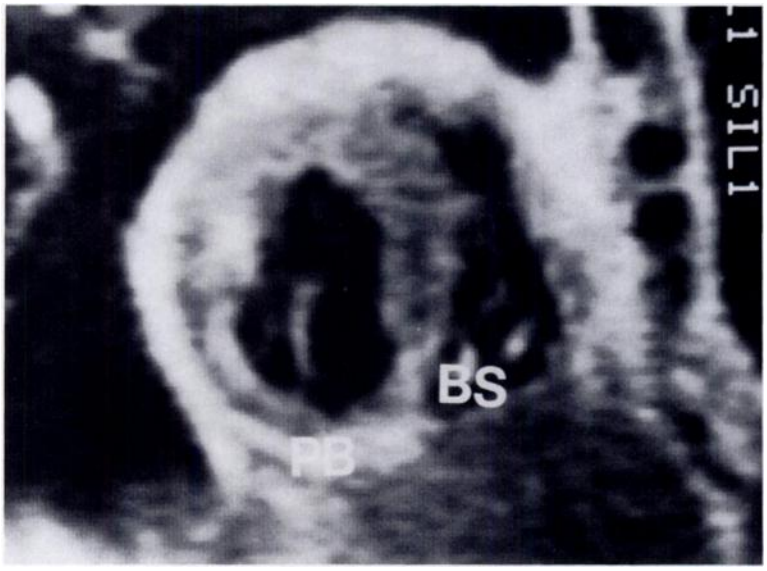


Figure 5
Fourier and MR images of inferior myocardial infarction (A) LAO amplitude image There is an area of diminished amplitude in the basal septal, BS, segment extending to the center of the left ventricle which could be overlooked. The remainder of the LV has normal amplitude. (B) LAO phase image This image appears normal with no region of delayed activation in the basal septal segment to correspond to the area of diminished amplitude seen on the LAO amplitude image. If the LAO phase image were the only image analyzed, the interpretation would be: Normal. (C) LPO amplitude image There is an obvious region of decreased amplitude (yellow pixels) in the posterobasal, PB, segment of the left ventricle. (D) LPO phase image There is a small region of delayed activation (green pixels) in the posterobasal segment, corresponding to the amplitude abnormality. The interpretation was of a regional wall motion abnormality in the basal septal and posterobasal segments, as determined from both LAO and LPO views. (E) Vertical long axis MR image There is a region of wall thinning involving the posterobasal, PB, segment of the left ventricle. (F) Short axis MR image There is wall thinning in the posterobasal, PB, segment extending to the basal septal, BS, segment. This patient had a proved infarction resulting from occlusion of the posterior descending branch of a dominant left circumflex artery.



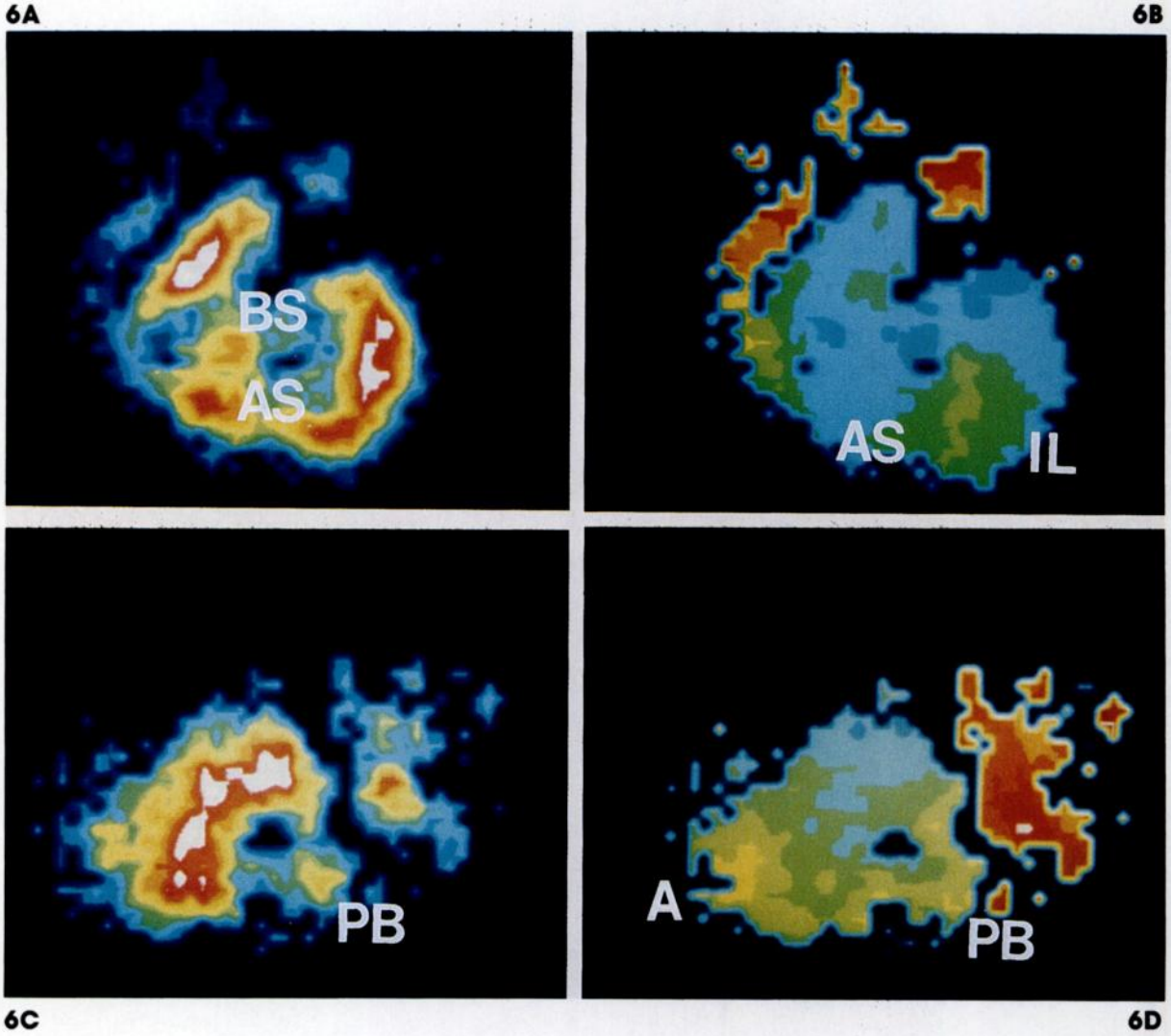
5E

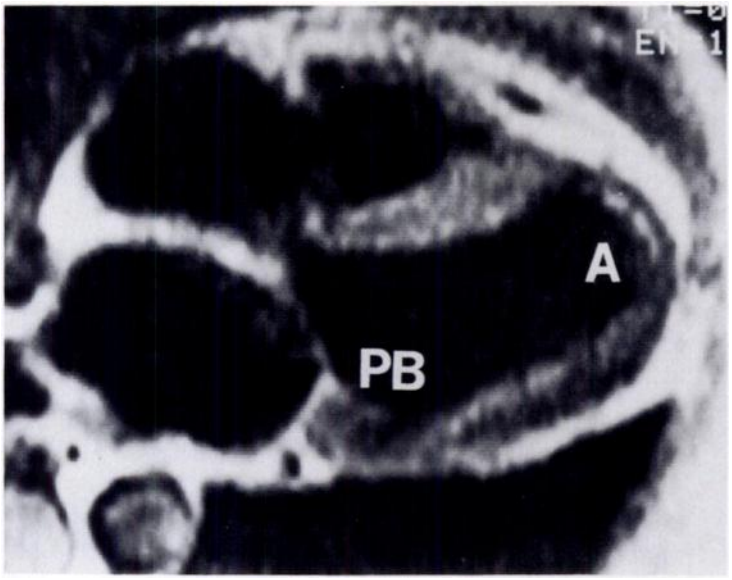


5F

A particular advantage of using biplane Fourier analysis is in the detection of multiple regional wall movement abnormalities caused by myocardial infarction involving two vascular territories. The most common combination of anteroseptal and inferior MIs (resulting from left anterior descending and right coronary artery occlusion) can be demonstrated conclusively with the use of the conventional LAO view in conjunction with the LPO projection (Figure 6).

Results





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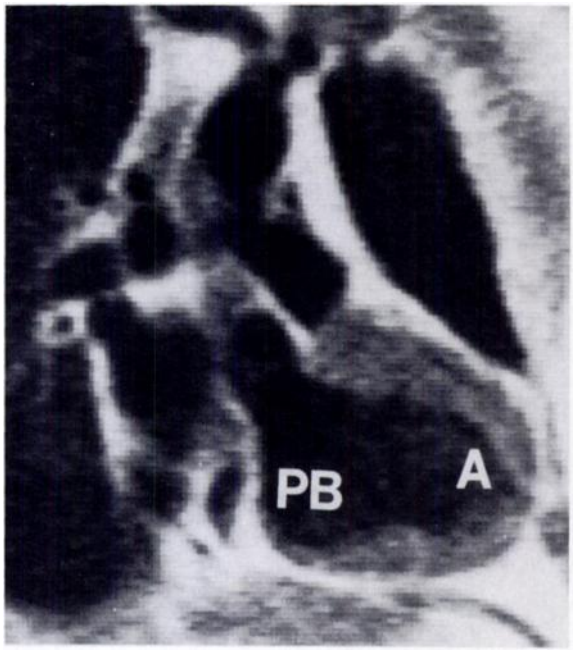

6F

Figure 6
Fourier and MR images of anterior and inferior myocardial infarctions (A) LAO amplitude image There is markedly decreased amplitude of the basal septal, BS, and apical septal, AS, segments, suggesting a single large septal MI. (B) LAO phase image There is a large area of delayed activation (green and yellow pixels) extending from the center of the left ventricle to the apical septal, AS, and inferolateral, IL, segments. The region of delayed activation does not correspond exactly to the region of decreased amplitude because the area of delayed activation does not include the basal septal segment. If these were the only two images available, however, the interpretation would be of a single anteroseptal infarction. (C) LPO amplitude image This image shows a large region of decreased amplitude in the posterobasal, PB, segment. If only the two amplitude images were available, the (erroneous) interpretation would be of a single infarct involving the basal septal and posterobasal segments. (D) LPO phase image This image provides unambiguous evidence for two separate infarcts. There is markedly delayed activation of the apical, A, and posterobasal, PB, segments. (E) Horizontal long axis MR image There are two areas of wall thinning in the apical, A, and posterobasal, PB, segments. The posterobasal abnormality extends into the lateral wall which is depicted in this slice. (F) Vertical long axis MR image This image also reveals thinning of apex, A, and posterobasal, PB, walls. This patient had infarctions in two vascular territories: the left anterior descending and right coronary arteries.

Results

COMPARISON OF VISUAL INSPECTION OF BEATING HEART IMAGES WITH SINGLE AND BIPLANE FOURIER ANALYSES AND MRI

Thirty-three healed MIs documented by CV or Q waves on ECG were present in 25 of the patients: 16 anterior, anteroseptal or anterolateral; and 17 inferior or inferoposterior (Table II). The mean ejection fraction was 35% ± 11. Only 16/33 (48%) of the MIs were detected by two observers from visual inspection of the beating heart images. Twenty-two of the 33 (67%) were identified using the phase and amplitude images from the LAO view only. Thirty of the 33 (91%) were identified using combined analysis of phase and amplitude data from both LAO and LPO views (Table III). The 9 additional MIs identified with the LPO view were all inferior wall infarctions. The 3 MIs not identified were also inferior wall lesions that had occurred in association with large anteroseptal MIs, suggesting that large left anterior descending artery lesions may hinder the detection of smaller right coronary artery lesions. Two of these three lesions could be identified in retrospect, and only one infarction was not in any way demonstrated by Fourier imaging.

TABLE II
NUMBER OF INFARCTS IDENTIFIED BY VISUAL INSPECTION, LAO AMPLITUDE AND PHASE IMAGES, AND LAO AND LPO AMPLITUDE AND PHASE IMAGES

Patient	Age	LVEF	Visual Inspection	LAO Amp + Ph	LAO + LPO Amp + Ph	MRI	True Number
1	60	24	1	1, Ant	1, Ant	1, Ant	1, LAD
2	48	33	0	1, Ant	1, Ant	0[1]	1, LAD
3	78	26	1	1, Ant	2, Ant, Inf	2, Ant, Inf	2, LAD, RCA
4	43	17	1	1, Ant	1, Ant[2]	2, Ant, Inf	2, LAD, RCA
5	58	40	0	1, Apical	1, Inf	1, Inf	1, RCA
6	57	34	1	1, Ant	1, Ant	1, Ant[3]	2, LAD, RCA
7	66	25	1	1, Ant	2, Ant, Inf	1, Ant[1,3]	2, LAD, RCA
8	66	36	0	1, Ant	1, Ant[2]	1, Inf	2, LAD, RCA
9	66	39	0	1, Ant	1, Inf	1, Inf	1, RCA
10	50	45	0	1, Ant	1, Inf	1, Ant[4]	1, RCA
11	73	48	0	0	1, Inf	0[5]	1, RCA
12	46	26	1	1, Ant	1, Ant	1, Ant	1, LAD
13	56	39	0	0	1, Inf	1, Inf	1, LCX
14	68	21	1	1, Ant	1, Ant	1, Ant	1, LAD
15	82	33	1	1, Ant	2, Ant, Inf	2, Ant, Inf	2, LAD, RCA
16	49	44	1	0	1, Inf	1, Inf	1, RCA
17	53	27	1	1, Ant	2, Ant, Inf	2, Ant, Inf	2, LAD, LCX
18	69	31	1	1, Apical	2, Ant, Inf	2, Ant, Inf	2, RCA, LCX
19	46	48	0	0	0	0	0
20	65	27	1	1, Ant	1, Ant	1, Ant	1, LAD
21	64	47	1	1, Apical	1, Inf	1, Inf	1, RCA
22	38	25	1	1, Ant	1, Ant	1, Ant	1, LAD
23	72	30	1	1, Ant	1, Ant	1, Ant	1, LAD
24	42	31	1	1, Ant	1, Ant	1, Ant	1, LAD
25	63	50	0	1, Apical	1, Inf	1, Inf	1, RCA
26	55	36	0	1, Apical	1, Inf	1, Inf	1, RCA
27	50	63	0	0	0	0	0

[1] Lesion seen in retrospect: not tangential to imaging plane.
[2] Inferior lesion seen in retrospect.
[3] Poor quality scan due to arrhythmia.
[4] Erroneous localization of MI by MRI.
[5] Appears normal in retrospect: no wall thinning in a good quality scan.

LAD = left anterior descending artery
LCX = left circumflex artery
RCA = right coronary artery.

Results

MRI prospectively demonstrated 28/33 (85%) of the MIs as areas of focal wall thinning, helping to substantiate the infarct location detected by radionuclide ventriculography. Two additional areas of wall thinning, conforming to the locations of known infarcts that were in areas which were not sectioned tangentially, could be identified in retrospective MRI analysis. Three infarctions were not identifiable by MRI at all. Two of these were in studies degraded by cardiac arrhythmias; only one small infarction could not be seen on a good quality image.

TABLE III
IDENTIFICATION OF 33 CHRONIC MI'S IN 25 PATIENTS

Visual inspection of cine-display	16/33	48%
LAO amplitude and phase	22/33	67%
LAO and LPO amplitude and phase	30/33	91%
MRI	28/33	85%

Discussion

Segmental wall motion abnormalities of the inferior wall cannot be evaluated adequately with the conventional anterior view, because radioactivity in the right ventricle obscures the inferior wall. They cannot be studied adequately with the 45° LAO view, because an abnormality in the caudal portion of the left ventricle may represent either an apical or an inferior wall motion abnormality. It is for this reason that several groups of workers have shown that the sensitivity of detection of inferior wall motion abnormalities by conventional radionuclide ventriculography can be significantly improved by the addition of either a steep (70°) LAO (*10*) or left lateral (*11*) view. This addition results in either a minor decrease (*10*) or no decrease (*11*) in specificity. This problem was recognized and addressed by Adam et al. in their original description of amplitude and phase analysis. They observed that the anterior and posterior walls of the left ventricle overlap in the 30° LAO projection and recommended the 60° LAO projection as an additional view to separate them (*1*). Unfortunately, this projection has not been adopted elsewhere. Although both RAO (*12*) and anterior (*13*) projections have been advocated, the standard single LAO projection remains the only view that is commonly utilized (*2,3,5,14,15,16*). This report is believed to be the first to describe the amplitude and phase image analysis of the LPO projection in hearts with healed MIs.

If only the LAO view is analyzed, inferior wall lesions are frequently not detected, resulting in a decrease in sensitivity (*5*). The use of the LPO projection overcomes this difficulty because the inferior wall is seen in profile, and its activity is not obscured by anterior wall activity. The decrease in the specificity of the detection of inferior regional wall motion abnormalities associated with the use of the 70° LAO view in conventional radionuclide ventriculography (*10*) was attributed to several possible factors. Among these was unrecognized overlap of the posterobasal segment by radioactivity in the left atrium. The use of the LPO amplitude and phase images for the detection of MIs should result in greater sensitivity (without a corresponding decrease in specificity) than the use of the LAO view of conventional radionuclide ventriculography alone. This follows because in the LPO amplitude and phase images, the left atrium is clearly distinguished from the left ventricle by the plane of the mitral valve. The valve is detected by Fourier analysis as a region in which no change in amplitude or phase occurs. As a result, the anterobasal and posterobasal segments of the left ventricle are visualized with clarity in both amplitude and phase images on the LPO view. They are nearly always obscured by radioactivity in the left atrium, pulmonary artery, aorta, in both vena cavae and both pulmonary veins in the LPO view of the conventional radionuclide ventriculogram.

Discussion

Although Fourier analysis of the radionuclide ventriculogram was recognized as a powerful tool by several groups of workers soon after its introduction, a recent textbook has noted that despite its advantages, Fourier analysis has not been widely adopted for the detection of regional wall movement abnormalities caused by coronary artery disease *(17)*. There are three major reasons for this: (1) the failure to employ the LPO projection to supplement the LAO projection as described above, (2) the failure of many groups to employ the amplitude image in conjunction with the phase image and, (3) the use of the left ventricular phase histogram as a quantitative measure of ventricular hypokinesis. Although several groups, such as Ell et al. *(2)*, Pavel et al. *(3,18)*, Botvinick et al. *(12)*, and Alcan et al. *(5,6)*, have emphasized the importance of utilizing both amplitude and phase images for the interpretation of regional wall motion abnormalities resulting from MI, other groups have ignored the amplitude image *(16,19)*. Fourier analysis results in the simultaneous generation of two functional images (amplitude and phase) by the same algorithm. It is essential to interpret the phase image in conjunction with the amplitude image, because a ventricular region with delayed activation represents a regional wall movement abnormality only if it is coupled with decreased amplitude at the same location. Another reason for underutilization of Fourier analysis is the use of the standard deviation and skewness of the left ventricular phase histogram as a quantitative measure of ventricular hypokinesis *(12,15,16)*. When large anterior or anteroseptal lesions are present, the increase in the standard deviation of the phase histogram is large and easily appreciated as a broadened ventricular peak. When small inferior wall infarcts resulting from the occlusion of the right coronary artery or left circumflex artery are present, the standard deviation of the LAO phase histogram may not increase significantly (because only a few pixels at the periphery are abnormal); or it may not increase at all, as shown in Figure 5. Moreover, in severe ventricular dysfunction, the phase histogram has been unable to separate coronary artery disease from other causes of dysfunction *(19)*. Our work, demonstrating that the interpretation of regional wall motion abnormalities caused by healed MIs is best accomplished by Fourier analysis utilizing both amplitude and phase images, is in complete agreement with the conclusions of Pavel et al. *(4)*. This study is believed to be the first to correlate the functional images resulting from Fourier analysis of the resting, gated scintigram with the excellent anatomic depiction offered by ECG gated MRI. This study also demonstrates that Fourier analysis of the resting radionuclide ventriculogram can reliably detect regional dysfunction in patients with severe left ventricular dysfunction resulting from ischemic coronary artery disease.

Conclusion

Fourier image analysis, when the study is performed using amplitude and phase images in both LAO and LPO projections of the radionuclide ventriculogram, is a useful adjunct to visual inspection of the cine display of beating heart images for the noninvasive detection and localization of healed myocardial infarction with wall thinning. The utilization of amplitude and phase images in both projections results in the detection of more healed myocardial infarcts than does the use of the LAO images alone, because inferior wall infarcts are much more readily visualized in the LPO projection.

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