

Superior Defect on 45 Degree Left Anterior Oblique Radiothallium Image: Is it a normal variation?

Amolak Singh, M.D., Michael G. Colln, M.D.
Columbia, Missouri.

DOI: <http://dx.doi.org/10.5915/20-2-13267>

Abstract

Superior defects involving approximately a proximal third of the septum and a proximal third of the posterolateral wall (basilar region) of the left ventricular myocardium on the 45 degree left anterior oblique (LAO) images are frequently encountered. Clinicians may presume the presence of coronary artery disease or normalcy but the exact statistical significance of such defects has never been established. In 45 patients who underwent radiothallium imaging and coronary arteriography, the presence or absence of superior defect was correlated with the presence of coronary artery disease (CAD) in the left anterior descending (LAD) and/or circumflex arteries (CA). Presence of superior defect on the 45 degree LAO image was not associated with increased frequency of CAD. Superior defects are observed in approximately one-third of patients undergoing radiothallium myocardial perfusion studies. In most cases the defects are fixed; reveal no redistribution on delayed imaging and represent normal variations. In a rare patient the defect may be reversible and presence of redistribution may be indicative of ischemia.

Introduction:

Defects on radiothallium images usually represent myocardial ischemia or scar due to coronary artery disease. However, abnormalities on the image may be due to normal variations. Awareness of such variations is important to reduce the errors in interpretation of radiothallium images. We have frequently observed a superior or basilar defect (approximately one third of septum plus proximal one third of posterior lateral wall) on the 45 degree left anterior oblique image. Such defects have been previously reported¹⁻³ but statistical correlation has never been made and mention of their defects is purely anecdotal. Normalcy or coronary artery disease in the branches of the left anterior descending and/or circumflex artery may be presumed until or unless coronary arteriography have alluded to its significance in a given patient. In this study we examined if there is any statistical correlation between

the presence of superior defect and coronary artery disease.

Materials and Methods:

This study included 65 patients who had undergone myocardial perfusion scintigraphy with thallium 201 and coronary arteriography over a two year period. Patients who did not have coronary artery anatomy documented by angiocardiography were excluded. Forty eight of sixty five patients had significant ($\geq 70\%$ stenosis) coronary artery disease. As shown in Table I forty patients had disease in the left anterior descending and/or circumflex arteries which supply the area of concern (superior or basilar myocardium). Eight others who had disease in the right coronary artery are excluded from this table. Seventeen individuals had normal or subcritical stenosis of coronary arteries. Stress thallium-201 scintigraphy was performed in conjunction with a graded exercise treadmill test (Bruce protocol). Two mCi (74MBq) of thallium-201 chloride were injected intravenously at the end of the graded exercise treadmill test determined by an end point, such as chest pain, exhaustion, or electrocardiographic changes of ischemia (ST depression > 1 mm). To enhance myocardial uptake of radiothallium the patients were exercised 30-60 seconds beyond the end point. Myocardial imaging was begun promptly after injection using a conventional standard field of view (SFOV) gamma scintillation camera equipped with a

*From the Department of Radiology
University of Missouri Health Sciences Center*

*Reprint requests: Amolak Singh, M.D.
Nuclear Medicine Service
Department of Radiology
University of Missouri Health Sciences Center
Truman Memorial Veterans Hospital
One Hospital Drive
Columbia, Missouri 65212*

Table 1. Superior defect on 45° left anterior oblique image and CAD*

Findings on Image	No. of Patients	CAD*
No defect (Group I)	43	30 (70%) +
Defect (Group II)	22	10 (45%) +
Total	65	40 (62%)

*CAD = Coronary Artery Disease in the left
= descending and/or circumflex arteries
+ Non-significant difference

low energy all purpose parallel hole (LEAP) collimator. Present timed images for a seven minute period per image (approximately 300 K counts) were recorded in the anterior, 45 degree left anterior oblique (LAO) and left lateral or 70 degree left anterior oblique projections. The thallium images were computer processed using a macro which produced background subtraction (lower threshold = 25) interpolation (64 × 64 matrix to 128 × 128 matrix) and standard nine point-smoothing.

All 65 studies were divided into two groups depending upon the absence or presence of a superior defect on the 45 degree LAO radiothallium image. Group I consisted of 43 (66%) patients with no superior defect and Group II included 22 (34%) patients with superior defect. In Group I there were 38 males, 5 females with mean age 48 ± 19 years. In Group II there were 21 males and 1 female with mean age 51 ± 16 years. Both groups were matched for age and sex. Since the area of concern, approximately proximal one third of septum and proximal one third of posterolateral wall is supplied by left anterior descending and/or circumflex arteries, only the incidence of coronary artery disease in these vessels were calculated and compared between two groups using chi-square contingency tables. A p value of < 0.05 was required for statistically significant difference.

Results

The coronary artery disease in the left anterior descending (LAD) and/or circumflex arteries was present in 30 (70%) in Group I and 10 (45%) in Group II patients (Table I). The difference was statistically insignificant ($p > .05$). In Group I, 26 had LAD disease as compared to 10 patients in Group II. The circumflex disease was seen in 18 in Group I compared to 6 in Group II. The differences in the CAD in these vessels between two groups were not significant. Therefore the presence of defect was

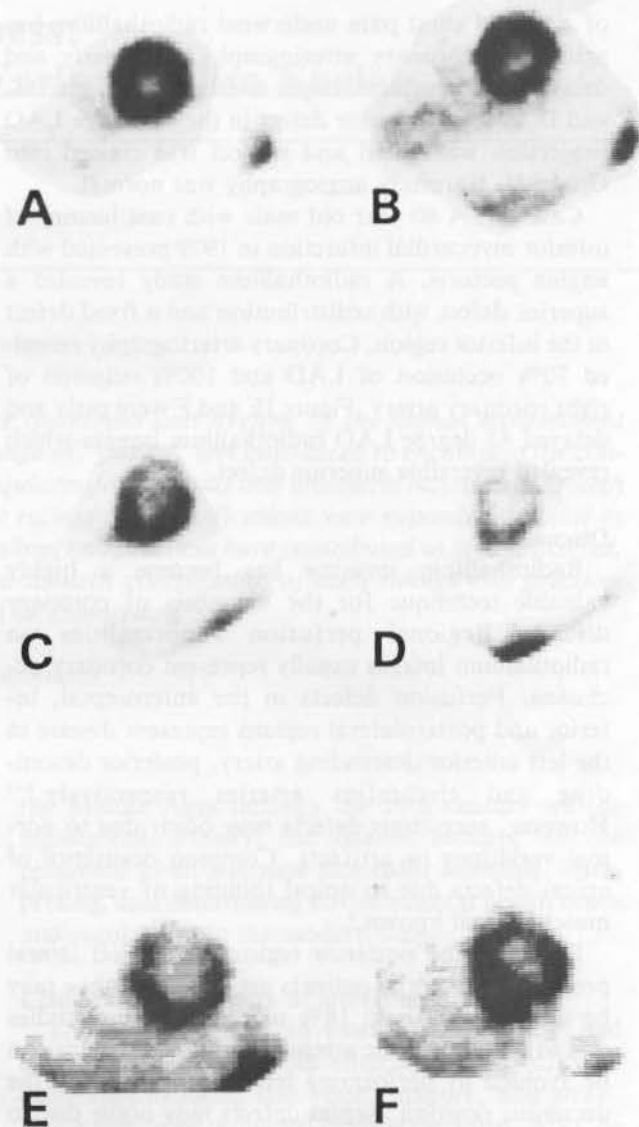


Figure 1 All radiothallium images are in 45 degrees LAO projection. A and B are early and delayed images in a patient with CAD and no superior defect (Case I). C and D are early and delayed images in a patient with normal coronary arteries (Case II). E and F are early and delayed images in a patient with CAD and reversible superior defect (Case III).

not associated with increased incidence of CAD in the left anterior descending or circumflex arteries.

Representative Cases:

Case I: A 60 year old male with subendocardial myocardial infarction was complicated by post-infarction anginal episodes. Coronary angiography revealed 70% stenosis of LAD and 100% occlusion of first obtuse marginal branch of circumflex artery. Figure 1A and B were early (stress) and 4 hour delayed (rest) radiothallium images taken in the 45 degree LAO projection. No superior defect was noted and subject was classed into Group I.

Case II: A 30 year old male with 5 months history

of a typical chest pain underwent radiothallium imaging and coronary arteriography. The early and delayed radiothallium images are shown in Figure I C and D. A fixed superior defect in the 45 degree LAO projection was noted and subject was classed into Group II. Coronary angiography was normal.

Case III: A 40 year old male with past history of inferior myocardial infarction in 1979 presented with angina pectoris. A radiothallium study revealed a superior defect with redistribution and a fixed defect in the inferior region. Coronary arteriography revealed 70% occlusion of LAD and 100% occlusion of right coronary artery. Figure IE and F were early and delayed 45 degree LAO radiothallium images which revealed reversible superior defect.

Discussion:

Radiothallium imaging has become a highly valuable technique for the diagnosis of coronary disease. Regional perfusion abnormalities on radiothallium images usually represent coronary occlusion. Perfusion defects in the anteroseptal, inferior and posterolateral regions represent disease in the left anterior descending artery, posterior descending and circumflex arteries respectively.⁴⁻⁶ However, suspicious defects may occur due to normal variations or artifacts. Common occurrence of apical defects due to apical thinning of ventricular muscle is well known.²

Defect in the posterior region on the left lateral projection when the patients are imaged supine may be observed in about 18% of radiothallium studies due to diaphragmatic attenuation.⁷ Such defects can be avoided by performing left lateral images in the decubitus position. Septal defects may occur due to photon attenuation by the female breast or breast implants.³ Inappropriate background subtraction by over-zealous computer processing or camera non-uniformity may also be associated with imaging artifacts.⁸

A superior defect on the 45 degree left anterior oblique projection of a radiothallium study is a normal variation and was seen in 34% of our patients. We found that the likelihood of coronary artery disease is not increased if such superior defect is the only finding on an otherwise normal study compared to a normal study without a superior defect. Data on individual vessels revealed that neither LAD nor circumflex artery disease is any more common in patients exhibiting superior defects on 45 degree LAO degree radiothallium images. In only two of our patients, reversibility of superior defect was noted on delayed images due to redistribution. Both patients had document disease in the LAD artery and we can presume that reversibility of defects in these patients

indicated ischemia. In all remaining patients, the defects were fixed and appear similar on the early post-exercise and delayed redistribution images. The explanation for presence of a superior defect on the 45 degree LAO radiothallium image has been postulated in the past. Aortic and mitral valves may be responsible for occurrence of superior defects¹ due to diminished photon flux compared to high photon flux from remaining left ventricular muscle mass. Alternately, the variabilities in the thickness and site of location of anterior papillary and posterior papillary muscles may be contributing to this variation.²

However, the former explanation appears more plausible. We conclude that superior defects on 45 degree LAO radiothallium images are normal anatomical variations in most patients. Only in a rare patient the defect is reversible and may represent ischemia.

References

1. Wackers F, Sokole E, Samson G, et al. Atlas of Tl-201 myocardial scintigraphy. Clin Nucl Med 1977; 2:64-74.
2. Cook DJ, Bailey I, Strauss HW, et al. Thallium-201 for myocardial imaging: Appearance of the normal heart. J Nucl Med 1976; 17:583-586.
3. Berman DS, Garcia EV, Maddahi J. Thallium-201 myocardial perfusion scintigraphy in Freeman and Johnson's Clinical Radionuclide Imaging, Freeman LM ed. Grune & Stratton Inc., 1984; pp479-537.
4. Nohara R, Kambara H, Suzuki Y, et al. Stress scintigraphy using single-photon emission computed tomography in the evaluation of coronary artery disease. Am J Cardiol 1984; 53:1250-1254.
5. Rigo P, Bailey IK, Griffith LSC, et al. Value and limitations of segmental analysis of stress thallium myocardial imaging for localization of coronary artery disease. Circulation 1980; 61:973-981.
6. Tzall WR, Sciaccia RR, Blood DK, et al. Bayesian analysis using fourier transforms of thallium-201 scintiscans to predict the presence of coronary artery disease. Am J Cardio 1984; 54:289-293.
7. Johnstone D, Wackers F, Berger H, et al. Effect of patient positioning on left lateral thallium-201 myocardial images. J Nucl Med 1979; 20:183-188.
8. Narahara KA, Hamilton GW, Williams DL, et al. Myocardial imaging with thallium-201. An experimental model for analysis of the true myocardial and background image components. J Nucl Med 1977; 18:781-786.