

The Value and Limitation of Thallium Scintigraphy in the Detection of Individual Coronary Artery Disease.*

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SUMMARY

In this study we randomly selected 45 patients whose coronary angiograms were abnormal i.e. showing triple, double and single vessel disease out of a pool of 80 patients who had undergone stress thallium imaging and coronary angiography during the one year period from June 85 to 86. Majority of these patients were males (43 out of 45), their ages ranged between 34-54 years (average = 48). Resting ECG's were normal in 25 patients, 15 patients had suffered inferior myocardial infarction and 5 had sustained anterior myocardial infarction in the past. Coronary angiography revealed triple vessel disease in 20 patients, double vessel disease in 15, and single vessel coronary artery disease in 10. We analysed their coronary angiograms and compared them with the scintigraphic findings.

It is concluded that although thallium scanning has high sensitivity for detection of coronary artery disease in general, it has only moderate sensitivity for detection of stenosis in individual coronary arteries. In this study thallium scan identified 75% of RCA lesions, 66% of LAD lesions and 38% of Circumflex lesions. Our results are in close correlation to the previous reports, so far as LAD and Cx lesions are concerned but the sensitivity for RCA lesions is greater. The probable reason is inclusion of higher number of patients with inferior infarcts. Thallium Scan sometimes fails to identify the less severe lesions in the presence of more severe coronary lesions in the same patient. The sensitivity is much higher in single vessel coronary artery disease.

INTRODUCTION

Exercise Thallium Scintigraphy is being used increasingly to evaluate patients with suspected or known coronary artery disease. Although several studies have now shown stress thallium scanning to be more sensitive than exercise tolerance test (E.T.T.) for detecting patients with ischaemic heart disease, (1,2) much less is known about the value of the technique for identifying narrowings

in the individual coronary arteries (3,4). In many situations more detailed knowledge of the coronary circulation is required. For example, to establish an indication for coronary artery bypass surgery (CABG) in mildly symptomatic patients or to plan the management of patients with previous myocardial infarction, it may be important to know whether the patient has single or multiple vessel disease and which artery or combination of arteries is involved.

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The value and limitations of stress thallium imaging (S.T.I.) in identifying disease in individual. Coronary arteries have recently been described (5,6). In this study we randomly selected 45 patients whose coronary angiograms were abnormal, i.e. showing single, double or triple vessel disease out of the pool of 80 patients who had undergone both Stress Thallium Imaging and Coronary Angiography.

We analysed their coronary angiographic lesions and compared them with the scintigraphic findings with a view to find out as to what extent this noninvasive technique (S.T.I) can be relied upon in the detection of individual coronary arterial lesions in the presence of Multiple or Single Vessel Disease.

MATERIALS AND METHODS:

The patient profile is as listed under Table I.

PATIENT PROFILE

Total No.	:	45
Sex: Males	:	43
Females	:	02
Age:	:	34-54 Years
Average Age	:	48 Years

Stress Thallium Imaging:

Every patient was exercised according to the modified Bruce Protocol on a Treadmill (Quinton 2000) with 12 lead ECG recording before starting the test and at the end of every stage. BP was also measured alongwith continuous 3 leads monitoring. The criteria for stopping the exercise included achievement of maximal predict heart rate, progressive angina, ST depression of more than 1 mm, frequent VPC's or other arrhythmias, fatigue and abnormal BP response. At the peak of exercise Thallous Chloride in a dose of 2-2.5 m. curie was injected through an antecubital vein and patient was exercised for a minute further. Within 5 minutes patient was shifted to G. camera and scans were done in anterior, LAO 45° and left lateral 90°, using 300, 000 counts for each view. Digi camera 404 from Scintag-Bert hold interfaced with camera analogue and the computer equipment, was used. The scans

were repeated in the same projections after 2-3 hours.

Thallium Scans were interpreted by three observers independently without the knowledge of stress E.C.G result or Coronary arterial lesions in patients who had coronary angio before TL 201 Scan. After the independent analysis scan reports were prepared by a joint decision.

CORONARY ANGIOGRAPHY:

L. V. Cineangiogram and Selective coronary angiograms were done in RAO 30°, LAO 60°, and left lateral position using Judkin's Technique. Coronary angiograms were interpreted by panel of Cardiologists during catheter conference and a joint report was prepared.

During analysis of Thallium Scans, the tracer defects were localised to four vascular areas as described by previous authors (3, 4, 6, 11). The defects in anterior wall and interventricular septum were ascribed to LAD disease, defects in posterolateral wall to left circumflex lesions and the inferior wall defects were considered to be due to the lesions of RCA. The apical defects were not interpreted as an independent lesion.

DATA ANALYSIS:

TABLE NO. II
Resting ECG findings
(N = 45)

Normal	:	25
Inferior M. I.	:	15
Anterior M. I.	:	5
Total	:	45

Resting ECGs of the patients understudy were analysed (Table II). 25 of them had absolutely normal ECGs, 15 showed evidence of old inferior myocardial infarction and 5 patients had evidence of old anterior myocardial infarction.

TABLE NO. III
CORONARY ANGIOGRAPHIC FINDINGS

(N = 45)

Triple Vessel Disease	:	20
Double Vessel Disease	:	15
Single Vessel Disease	:	10

35 patients (20+15) out of a total 45 had involvement of more than one coronary arteries or their branches. 10 patients suffered from a single vessel coronary artery disease (CAD). None of these patients had a left mainstem disease (Table III). The stress thallium scan was positive with multiple vessel coronary artery disease (M.V.CAD) for a tracer defect in all the 35 patients Table IV.

TABLE NO. IV

ANALYSIS OF SCINTIGRAPHIC RESULTS IN MULTIVESSEL CAD: (N = 35)

Degree of Stenosis	No. of Vessels Involved	Tracer Defect	
		+	-
100%	45	36	9
Above 70%	25	15	10
50 - 70%	20	7	13
TOTAL	90	68	32

Analysing the results in Multiple Vessel CAD, we found Thallium 201 Scan identified more than 80% of the lesions accurately. Thallium Scan failed to show tracer defects in some of the 100% stenoses which were present in more than one vessel in a patient. The sensitivity falls to below 60% when vessels with less severe stenoses are studied in the presence of more severe lesions.

TABLE NO. V

SCINTIGRAPHIC RESULTS IN LAD LESIONS IN THE PRESENCE OF MULTIPLE VESSEL DISEASE (N=32)

Stenosis	No. of Vessels Involved	Tracer Defect	
		+	-
100%	15	13	2
Above 70%	10	6	4
50% - 70%	7	2	5
TOTAL	32	21	11

Positive Scintigraphic results were obtained in 95% of the LAD lesions with 100% stenoses (Table V). Two patients with negative scans in the presence of 100% block had inferior infarcts due to complete blockage (100%) in their Rt. coronary arteries with good collaterals to LAD from big O.M branches of left circumflex. Both these patients were in a relatively younger age group, i.e. , 36 and 40 years of age. 50% of the less severe lesions were missed.

TABLE VI

RESULTS OF TL201 SCAN IN CIRCUMFLEX LESIONS IN M. V. CAD (N=18)

Stenosis	No. of Vessels	Tracer Defect	
		+	-
100%	10	5	5
Above 70%	3	1	2
50% - 70%	5	1	4
TOTAL	18	7	11

"Sensitivity of TL201 Scan falls to below 50% when the results are analysed for detection of circumflex lesions (Table VI). Even the complete occlusions may be missed. The reason may be (1) small territory supplied by Cx artery which may be perfused through collaterals from RCA or LAD arteries. (2) The territory lies away from the gamma-camera and all the energy photons do not reach the camera."

TABLE VII

SCINTIGRAPHIC FINDINGS IN RCA LESIONS IN M. V. CAD (N=40)

Stenoses	No. of Vessels	Tracer Defect	
		+	-
100%	20	18	2
Above 70%	12	8	4
50% - 70%	8	4	4
TOTAL	40	30	10

More than 90% of the RCA lesions were identified on Thallium Scan when the severity of stenosis was 100%, with the less severe lesions the results are comparable to LAD lesions Table VII. Compared to the most of the reported series, the sensitivity in the detection of RCA lesions in our study is somewhat higher. The reason probably is the inclusion of large number of patients with inferior infarcts and the infarcted area is rarely missed on thallium scan.

TABLE NO. VIII
SENSITIVITY OF STRESS THALLIUM SCAN
IN THE INDIVIDUAL VESSELS IN M. V. CAD
IN THIS SERIES

RCA	:	75%
LAD	:	66%
Left Circumflex	:	38%

The sensitivity of S.T.I in the identification of individual coronary arterial lesions (Table VIII) in our series of 35 patients (10 patients had single vessel disease only) showed a relatively higher value for R. C. A lesions which is in contradistinction to previous reports (3,4). The probable reason is the inclusion of relatively more cases of inferior infarcts. The sensitivity of localization of lesions for LAD and left circumflex is in close correlation to the earlier studies. (5,6).

TABLE NO. IX
SCINTIGRAMS IN SINGLE VESSEL DISEASE
(N = 10)

Degree of Stenosis	No. of Vessels	Tracer Defect	
		+	-
100%	4	4	0
Above 70%	4	2	2
50% - 70%	2	1	1
TOTAL	10	7	3

In ten patients with single vessel disease all those lesions with 100% stenosis were picked up on Thallium Scan, however in 6 patients with above 50% stenotic lesions 3, were missed (Table IX).

TABLE NO. X
FURTHER BREAKDOWN OF SINGLE VESSEL LESIONS

	Number	Tracer Defect	
		+	-
RCA LESIONS	= 4		
100%	= 2	2	-
50%-80%	= 2	-	2
LAD LESIONS	= 3		
100%	= 2	2	-
80%	= 1	1	-
CIRCUMFLEX LESIONS	= 3	-	1
TOTAL	= 10	7	3

On further analysis it is found that sensitivity in detection of LAD lesions is best, moderate in RCA lesions and least in Circumflex lesions (Table X). In any case no definite conclusion can be drawn from the study of such a small sample of patients.

DISCUSSION

In our patients with significant coronary artery disease the frequency of abnormal rest or post-exercise scintigrams was 100% a figure slightly higher than previous reports. The high value undoubtedly reflects our patient population, which included a large number of patients with previous infarcts and with severe arterial lesions.

In patients without prior infarction the sensitivity for detection of disease in general as well as for stenoses in individual coronary arteries would be expected to be lower (7). As in other studies Thallium Scintigraphy was more sensitive than electrocardiography for detecting coronary artery disease. In our patients with CAD we found that analysis of scintigrams in three views, i.e. , anterior view, LAO 45° and left lateral (90°) view were highly specific for the individual coronary artery lesions.

The most important limitation of TL Scan for identifying disease in individual coronary arteries is its relatively low sensitivity a problem noted by several investigators 4,8,9,10. We found that the detection rate was dependent on the severity of narrowing but even for 100% occlusions was only 66% for LAD, 75% for RCA and 38% for Lt Cx disease using the specific left ventricular walls. In our small series, the sensitivity for RCA lesions was higher than most of the reported studies (3,4). The reason was probably inclusion of a large number of patients with inferior infarcts. Sensitivity for LAD lesions and for L Cx lesions is in close coincidence with most of the reported studies.

In most of the reported studies sensitivity of TL 201 for LAD disease is higher than left Cx or RCA lesions. The reason is the anterior location of LAD close to Camera, and its larger territory of supply (3,4,6,11).

In single vessel lesions the sensitivity of TL201 Scan is much higher in the localization of

individual coronary artery lesions as compared to multiple vessel disease. The sensitivity for localization improves as the number of diseased vessels decreases (10,11,13).

KEY :-	RCA	=	Right Coronary Artery
	LAD	=	Left Anterior Descending
	LCx	=	Left Circumflex
	M.V.D	=	Multiple Vessel Disease
	No.	=	Number

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