

Correlation of Resting ECG, Stress ECG & Thallium Scan in the Evaluation of Coronary Artery Disease

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SUMMARY

This study includes 70 cases who underwent Myocardial Perfusion Studies with Thallium 201 during the years 1984-1985. They were studied clinically, had their Resting ECGs, Stress ECGs and Coronary Angiograms. Majority of these patients were males (64 out of 70), their ages ranged between 34 - 70 years (average 51 years).

The patient population included those with typical/atypical chest pain, some with resting ECG abnormalities, some after coronary angiography and a few after coronary artery bypass graft surgery.

The results of all the modalities were compared with the conventional gold standard for Ischaemic Heart Disease, i.e., coronary angiogram.

It is concluded that the sensitivity of resting ECG in the diagnosis of ischaemic heart disease is very low. The exercise test alone was found conclusive in about 74% of patients while sensitivity of Thallium Scan was 36% in this particular group of patients.

INTRODUCTION

One of the most challenging and frequent problems in clinical cardiology is the detection and extent of Coronary Artery Disease (CAD). The exercise ECG appears to be an excellent method for screening but is limited by equivocal and falsely positive and negative results (Antonio, etal).

The use of this method is even more limited when it is necessary to evaluate patients with an abnormal resting ECG or patients who are unable to discontinue cardiac drugs that can alter the results of exercise test (Botvinnik, etal).

In the last decade or so radioisotope imaging using potassium ionanalogue tracers like TL201 has been suggested as an important adjunct to the non-invasive diagnosis and evaluation of CAD.

Thallium Scanning was started in 1984 at Nuclear Medical Centre Armed Forces Institute of Cardiology. By the end of 1985 we had studied 80 cases out of whom 70 patients have had their coronary angiography. The data of 70 cases is presented.

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MATERIALS AND METHODS

PATIENT SELECTION

TOTAL NUMBER	—	70
AGE RANGE	—	34-70 YEARS
AVERAGE AGE	—	51 YEARS
MALES	—	64
FEMALES	—	06

Total number of patients was 70. 60 patients out of these were advised TL 201 scan at AFIC. While 10 patients were referred for thallium scan from elsewhere.

TYPE OF PATIENTS

TYPICAL/ATYPICAL CHEST PAIN	—	10
RESTING ECG ABNORMALITIES (LBBB, RBBB, ST, T Changes)	--	5
Post CORONARY ANGIOGRAM	—	47
Post CABG SURGERY	—	6
ROUTINE CHECK UP	—	2

Ten patients with chest pain had either normal or non-specific ECG changes and their exercise tolerance test was inconclusive or equivocal. 5 patients presented with resting ECG abnormalities of LBBB, RBBB, and ST, T changes. These were the cases where exercise tolerance test could not be interpreted accurately.

47 patients were advised Thallium Scan after coronary angiography because their symptoms could not be co-related to the lesions found on coronary angiography. In some cases type of therapy, i.e., medical or surgical could not be decided on coronary angiography alone. It must be pointed out here that due to Logistic problem of TL 201 isotope, we had to shortlist our patients for coronary angiography, a procedure which is being performed here since 1980. Six patients were advised thallium scan after CABG surgery, for evaluation of their chest pain.

Out of the last two patients one was an African Airline Pilot. This was a requirement

of the Airline. The other patient was advised thallium scan by the medical officer of his insurance company.

METHODOLOGY

Every patient was exercised according to the modified Bruce Protocol on a calibrated motor driven treadmill with the 12 leads ECG recording. Blood pressure was recorded using a cuff-sphygmomanometer before starting the exercise and at the end of every stage. Before starting the exercise a butterfly needle of 19-21 guage was placed in an arm vein with a saline syringe attached to it.

The criteria for stopping the exercise was the same as for a simple Exercise Tolerance Test (ETT), i.e, feeling fatigued, unable to continue due to pain in legs or chest pain, abnormal B.P. response, frequent VPC's, ST depression of 1.5 mm or more and after having achieved a predicted maximum heart rate. At the peak of exercise 2.5 m curies of thallium was injected and patient was exercised for a minute after injection. Within about 5 minutes after exercise, patient was shifted to gamma camera.

Digi camera 404 from Scintag Bert Hold was used with a low energy, high resolution collimator. The camera is interfaced with the computer equipment from the same company. Scanning was done in three views anterior, LAO 45° and left lateral view (almost conventional view) 300,000 counts were used for every view, taking about 8-10 minutes for each.

After the three views patients were allowed to leave and return after 3 hours for delayed pictures in the same '3' views in the identical position, during this period they were not allowed to do heavy exercise or take a heavy meal.

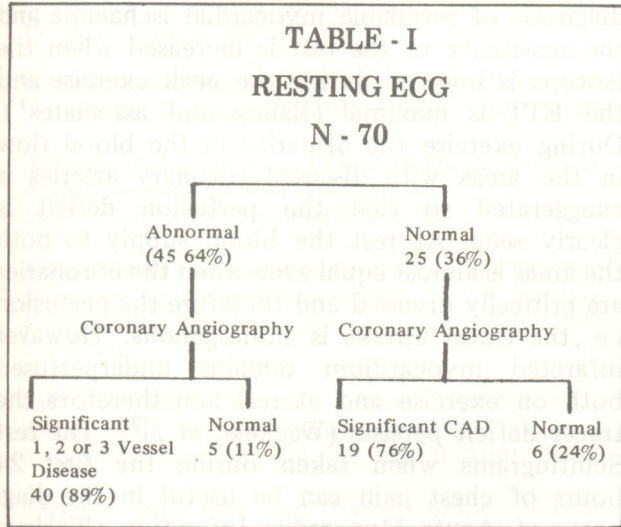
Computer images were obtained for subsequent analysis. Image interpretation was based solely on the original computer scintigraph. In most of the pictures no background subtraction or contrast enhancement was applied.

Coronary Angiograms were done using Judkin's technique in all the patients. L.V cineangiograms were done in RAO 30 degree. Selective coronary angiograms were done using

Judkin's Right and Left coronary catheters in RAO 10°, RAO 30, LAO 60 and true left lateral positions. Interpretation of coronary angios was done by a panel of cardiologists.

RESULTS

The results of Resting ECG's, Stress ECG's and Thallium Scan were judged against coronary angios.



Total number of abnormal resting ECG's in the mixture of 70 was 45, while in 40 of these coronary angios did show critical disease in 1, 2 or all the 3 vessels. Out of remaining 25 patients 19 had significant coronary artery lesions. While in 6 of them the coronary angios were normal.

It is well known now that the sensitivity of resting ECG in the diagnosis of CAD is very poor.

CORRELATION OF EXERCISE TOLERANCE TEST TO CORONARY ANGIOS IN 70 CASES

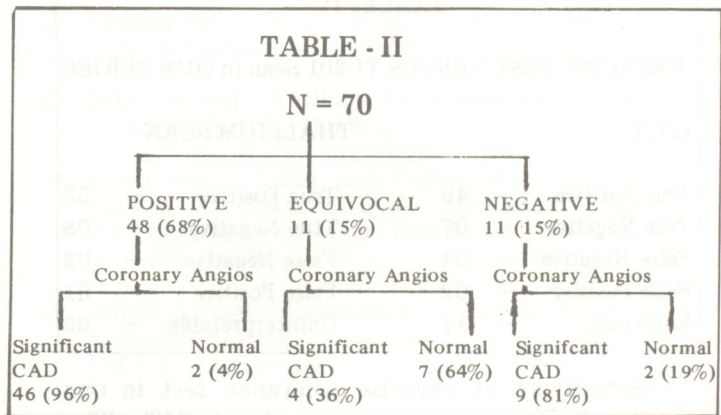
In must mention here that these results are from the exercise tolerance test which was carried out as part of Thallium Scan.

This table compares results of Exercise Tolerance Test with coronary angiograms.

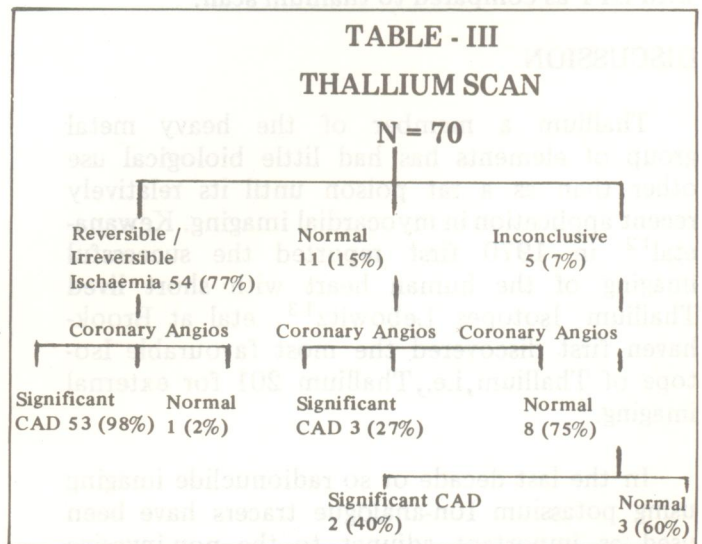
Exercise tolerance test was positive in 48 cases, however two of them had a normal coronary

angiogram. Out of 11 patients with negative E.T.T 9 had significant coronary artery lesions on angiograms.

In 11 patients Exercise Tolerance Test was interpreted as equivocal. In 6 of these heart rate achieved was less than 85% of maximal predictable or ST depression was less than 1 mm or it was upsloping. Three out of these 6 patients were females. The remaining 5 patients had resting ECGs changes with LBBB, RBBB & ST, T abnormalities. In this group of 11, 4 had significant disease on coronary angiograms, while 7 patients had normal coronary arteries.



54 patients had some defect in the tracer up-take, 53 out of these had the tracer defect with corresponded closely to the coronary arterial anatomy in the affected area. In one patient there was a persistent defect in the inferior zone while coronary angiogram was absolutely normal. In 11 patients with normal thallium scan, 3 had significant coronary artery



lesions. Thallium Scan was not interpretable in 5 patients and the reason was inadequate exercise resulting in high background activity. 3 of them were females, one was a 65 years old lady with triple vessel disease and poor L.V. function, the other two had normal coronaries. Two were with severe L.V. dysfunction and triple vessel coronary artery disease. In five patients in whom a particular stenosis was considered non-critical, i.e., below 70%, there was a definite zone of reversible ischaemia. The sensitivity of Thallium Scan in this selected group of patients comes to about 86%.

TABLE - IV

EXERCISE TEST VERSUS TI 201 Scan in OUR SERIES

E.T.T		THALLIUM SCAN	
True Positive	— 46	True Positive	— 53
True Negative	— 07	True Negative	— 08
False Negative	— 04	False Negative	— 03
False Positive	— 02	False Positive	— 01
Equivocal	— 11	Uninterpretable	— 05

Sensitivity of exercise tolerance test in our series of 70 cases comes to about 74%. The reason for the comparatively low sensitivity in our cases as compared to the other reported studies is inclusion of a large number of patients with equivocal tests and patients with resting ECG changes in whom interpretation of exercise tolerance test becomes difficult. It is evident from the table that incidence of false positives, false negatives and equivocal tests is more frequent with ETT as compared to thallium scan.

DISCUSSION

Thallium a member of the heavy metal group of elements has had little biological use other than as a rat poison until its relatively recent application in myocardial imaging. Kewana-etal¹² in 1970 first reported the successful imaging of the human heart with short lived Thallium Isotopes Lebowitz¹³, etal at Brookhaven first discovered the most favourable Isotope of Thallium, i.e., Thallium 201 for external imaging.

In the last decade or so radionuclide imaging using potassium Ion-analogue tracers have been used as important adjunct to the non-invasive

diagnosis of coronary artery disease. Out of these Thallium 201 has proved to be the most satisfactory for clinical use because of its 73 hours physical half life, 80 Kev low energy photon, biological distribution and low total body and gonadal radiation dose.

The distribution of Thallium in the myocardium depends on coronary blood flow plus the integrity of myocardial cell metabolism. The main usefulness of Thallium Scan lies in the diagnosis of reversible myocardial ischaemia and the sensitivity of the test is increased when the Isotope is injected during the peak exercise and the ETT is maximal (Bailey and associates¹). During exercise the disparity in the blood flow in the areas with diseased coronary arteries is exaggerated so that the perfusion deficit is clearly seen. At rest the blood supply to both the areas is almost equal even when the coronaries are critically diseased and therefore the perfusion, i.e., the tracer uptake is homogenous. However infarcted myocardium remains underperfused both on exercise and at rest and therefore the tracer deficit persists (Wackers, et al²). The rest Scintigrams when taken during the first 24 hours of chest pain can be useful in the diagnosis of Acute Myocardial Infarction (Wackers and Associates²).

Although the sensitivity and specificity of the stress Thallium Scans varies from centre to centre depending on patients selection and technique it appears to be in the range of 85-90% compared to 70-80% for exercise ECG (Hamilton etal, Botvinki etal⁹ Verani etal). The sensitivity is best in patient with single vessel critical disease as compared to double or triple vessel disease where generally reduced perfusion on exercise or at rest may be interpreted as uniform and therefore normal (Virandirji etal) or the tracer deficit may be detected in the area of most critical lesion only.

In the selected group of 70 patients that we studied it can be concluded that, TL201 Scan is not only of particular use in patients with resting ECG abnormalities of LBBB, RBBB and ST, T changes where interpretation of exercise ECG becomes difficult, but is of particular importance in the evaluation of cases where coronary angiographic findings do not correlate with the patient's symptoms. Moreover Thallium Scanning is a reliable non-invasive test in the fol-

w-up of patients after CABG surgery or angioplasty thus reducing the patient's exposure to the invasive/expensive tests like coronary angiogram.

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