



Stress Myocardial Perfusion Scintigraphy in Triple Vessel Disease – Role of TID in Balanced ischemia

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Abstract

Introduction: Stress myocardial perfusion scintigraphy has been one of the sensitive modalities to diagnose inducible ischemia. Theoretically one of the major pitfalls quoted is the lack of sensitivity in triple vessel disease due to balanced hypoperfusion. The aim of this investigation is to evaluate the efficacy of Gated Stress Myocardial Perfusion (MPI) SPECT in known patient of Triple Vessel Disease (TVD).

Materials and Methods: 34 patients of known TVD were subjected to single day Gated stress MPI using Tc99m sestamibi.

Results: Out of 34 patients perfusion abnormalities were detected in 31 patients (91.2%). Twenty-three of them (67.6%) had the defect in the territory of LAD, 11 (32%) in LCX and 25 (73.5%) in RCA. Transient Ischemic Dilatation (TID) was found in 24 patients (70 %) associated with perfusion defect. One out of three patients with normal perfusion showed TID. False Negative rate for hemodynamically significant coronary artery stenosis if only perfusion defects are evaluated is 2.94%. Management decision changed in 11 patients out of 34 patients (32.3%). With increase in the percentage of coronary stenosis there is increase in probability of occurrence of perusion defects on myocardial perfusion scan.

Conclusion: This study showed that combined assessment of perfusion patterns and gated SPECT help in risk stratification, TID can help in TVD with balance ischemia, However it is commonly associated with perfusion defects.

Keywords: Gated SPECT, Triple Vessel Disease, Transient Ischemic Dilatation.

Introduction

Stress myocardial perfusion scintigraphy has been one of the sensitive modalities to diagnose inducible ischemia. Theoretically one of the major pitfalls quoted is the lack of sensitivity in triple vessel disease due to balanced hypoperfusion.

The quantitative Gated Single Photon Emission Computed Tomography (SPECT) has improved the sensitivity in multiple coronary vessel disease significantly¹. Frequently, stress myocardial perfusion imaging (MPI) is used to assess areas with the most ischemia to guide therapeutic intervention. It has been demonstrated that there is

no difference in sensitivity or specificity for diagnosing coronary artery disease between three commercially available tracers². In particular the number of reversible defects is directly proportional to the risk of significant events². In this study we evaluated patients with known triple vessel disease using exercise or pharmacological (Dobutamine) stress for testing with quantitative gated SPECT MPI. The objective is to evaluate the incidence of Transient ischemic left ventricular dilatation (TID).

Materials and Methods

A prospective study, single institutional study was conducted in patients with angiographic evidence of Triple vessel coronary artery disease on conventional angiography within 3 months. we evaluated 34 adult patients. Patients were excluded from the study if they had undergone previous therapeutic coronary intervention, Pregnant or Lactating woman, Hypersensitive to radiopharmaceutical, Recent myocardial infarction (less than 72hrs), Uncontrolled hypertension & Left main critical stenosis with rest symptoms. Thirty were male and four were female. The study was approved by hospital ethics committee. The patients underwent single day Stress (exercise/ Pharmacological) & Rest MPI with 99mTc labelled methoxyisobutylisonitrile (MIBI).

Stress Techniques

Patients were given following instructions, 1) at least 4 hours fasting before the study, 2) They are advised to withhold β -blockers for 72 hours, calcium channel blockers for 24 hours and nitrates on the day of the test, 3) Patients are advised to fatty meal.

99mTC labelled sestamibi was injected at the peak stress (Exercise/Pharmacological) and at resting. Dosage 8-10mCi (296 -370MBq) for stress study and 20-30 mCi (740-1110MBq) for rest study in a single day protocol.

Positioning and Acquisition

Imaging was performed on Siemens E Cam Gamma Camera (Dual Head). Patient comfortably positioned. Imaging was commenced 45 min after

either stress or rest injection using single day protocol. Images were acquired with a Dual-head rotating large field of view camera, equipped with a low-energy, parallel-hole, all-purpose collimator. Both detectors at 90° configuration circular orbit starting from -45° right anterior oblique to +135° left posterior oblique with the patient in the supine position with the energy discriminator set at peak energy of 140 keV and a 20% symmetric window with analog zoom of 1.45, Projections(n = 32), 64X64 matrixes, 32 views, step & shoot, 25-30 seconds each frame. Circular and step and shoot method. Raw images were reconstructed by filtered back projection method. The tomographic data were used to reconstruct the left ventricle in the short-axis, horizontal long-axis and vertical long-axis orientations. Projection images were processed with a Butterworth filter having a cutoff frequency of 0.45 cycles per pixel and an order of 5. Cardiac SPECT images were reviewed independently by Nuclear Medicine Physician & Cardiologist and compared with coronary angiography.

Image Interpretation

SPECT images were interpreted visually & with adjunctive semi-quantitative analysis. Perfusion defects were defined as 30% or more decrease of myocardial tracer uptake in inferior wall and anterior wall of female and 20% or more decrease in other walls of left ventricle in stress, the anterior wall and septum were considered the territory of LAD; the inferior wall, the territory of RCA and the lateral wall, the territory of LCX. TID was measured by comparing ventricular cavity of stress with Rest SPECT images. TID values > 1.18 in men & > 1.22 in women were considered positive²⁴.

Coronary Angiography

Coronary angiography was performed within 3 months of MPI study were considered & visually interpreted by experienced cardiologists. All data has been divided into three categories: Borderline stenosis, moderate stenosis and severe stenosis based on coronary angiography interpretation. Borderline stenosis is classified as 60 -70 %

stenosis, moderate cases included $\geq 70\%$ & $< 90\%$ stenosis, except stenosis $\geq 70\%$ in the proximal left anterior descending artery (pLAD) or the left main (LM). Severe CAD is defined as $\geq 90\%$ stenosis.

Statistical Analysis

Data was entered in Microsoft excel spread sheet version 2003. Data was categorized as presence on perfusion defect as Y and absence of disease as N, and then expressed in actual numbers. Using 2 x 2 table sensitivity for detection of perfusion defect was estimated.

Results

In a total of 34 patients with Tc 99m-sestamibi myocardial perfusion scintigraphy and documented TVD in CAG, 30 patients were males and 4 females.

The inducible ischemia was found in all 34 patients (100 %). 26 ischemic defects in the territory of LAD (76.4%), 11 in LCX (31%) and 24 in RCA (70.5%). Total 64 ischemic defects were noted. Lateral wall was preserved in most of the

cases (67.6%). LAD territory was most commonly involved.

TID was associated with 36 ischemic perfusion defects (56%), of which all 26 ischemic defects in LAD territory (100%) showed TID, 2 in LCX (18%) and 8 in RCA territory (33.3%).

With increase in the percentage of coronary stenosis there is increase in probability of occurrence of perfusion defects on myocardial perfusion scan.

However incidence of TID is higher with ischemia in LAD territory than in any other coronary territory. As the coronary stenosis increased the severity and extent of ischemia increased proportionally.

Relation between TID ratio and perfusion defect

The relation between the TID ratios and ischemic defect showed the LAD territory involvement had the biggest percentage of abnormal TID. There are significant increases of abnormal TID ratios with increase in severity of lesion on CAG.

Fig 1: Normal perfusion of tracer both a stress and rest

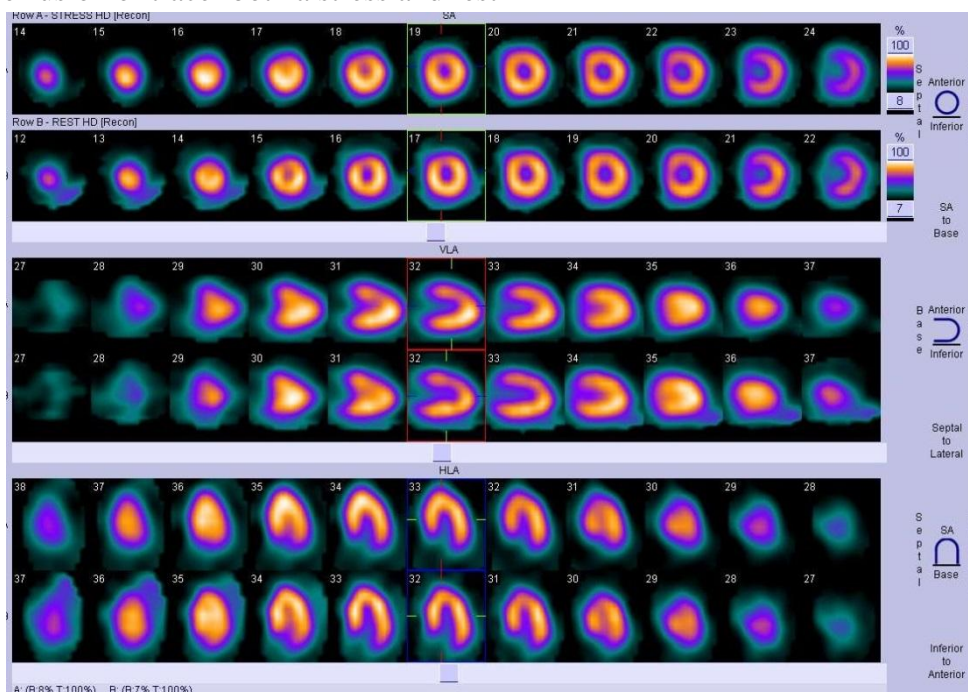


Fig 2: Stress inducible ischemia in LAD territory

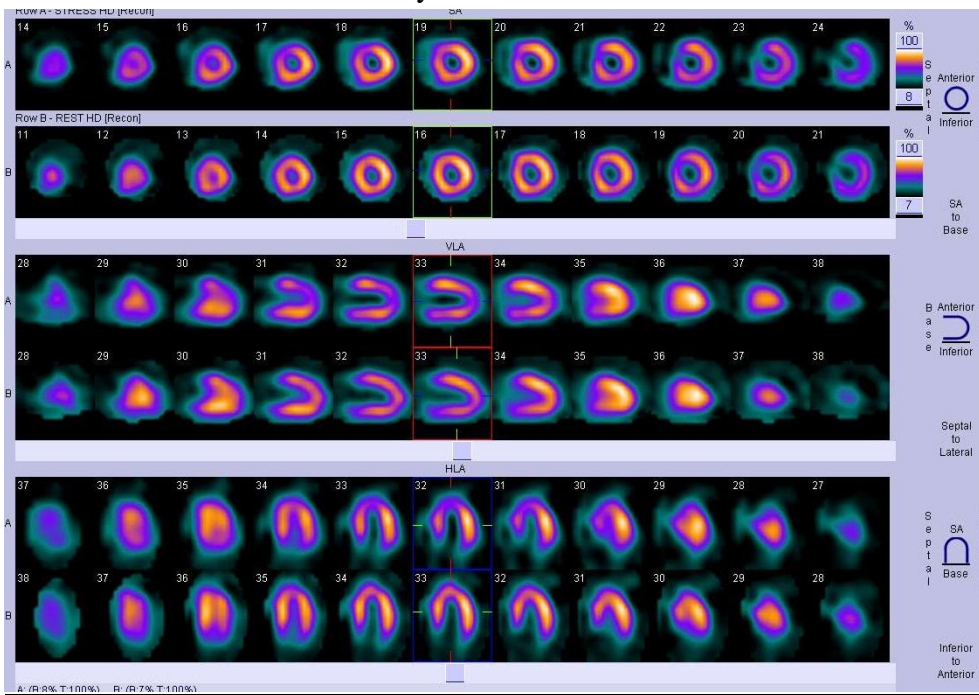


Fig 3: Stress inducible ischemia in LAD & RCA territory

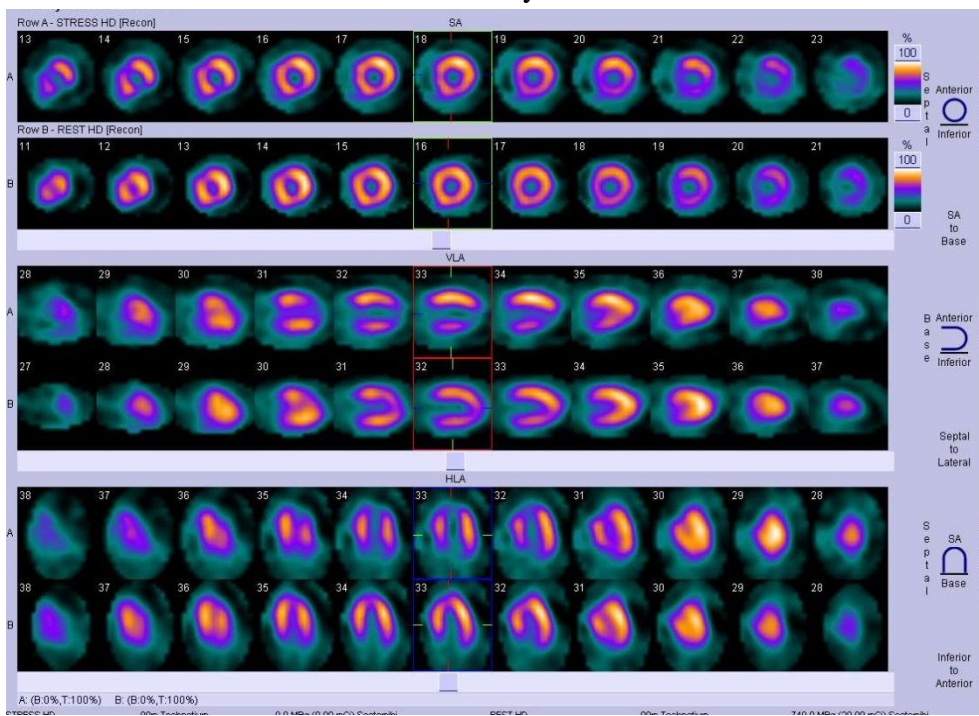


Fig 4: Stress inducible ischemia in LAD, LCX and RCA territory

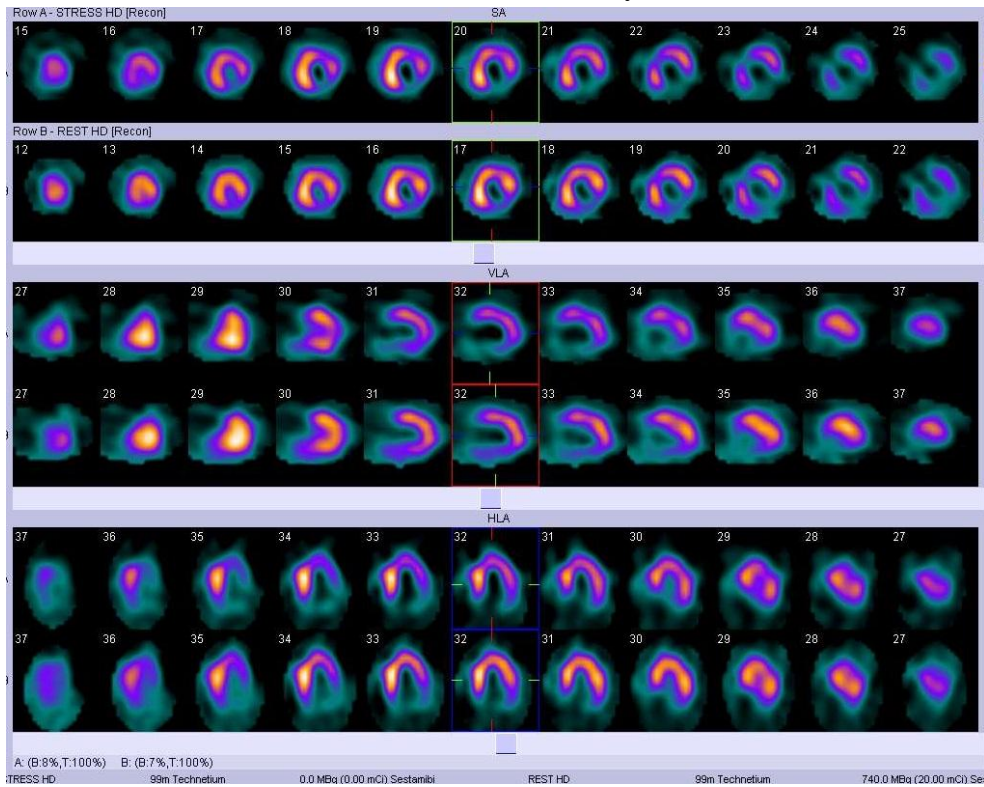
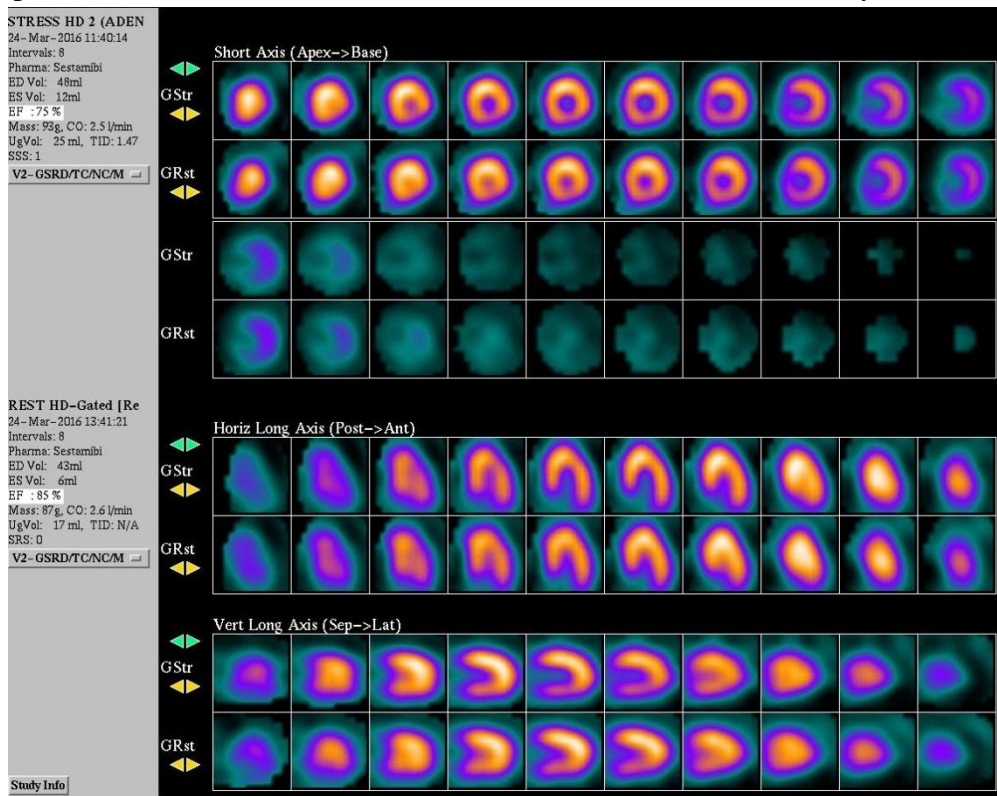


Fig 5: Normal perfusion with Transient Ischemic Dilatation and Stress induced dysfunction



Discussion

There are 64 ischemic defects in 34 patients with TVD. LAD territory was most commonly involved with preserved lateral wall. Because the

Tc99m Sestamibi distribution reflects relative rather than absolute reduction in myocardial blood flow, areas with less hypoperfusion may appear relatively normal compared with the most severely

hypoperfused segments. The normal distribution of post exercise ^{99m}Tc sestamibi uptake for men and women showed the highest activity on the lateral wall³. The lateral wall tends to have more counts than the other wall even if it is abnormal. SPECT images are normalized to the region of the myocardium having the greatest count density. Therefore, in cases of inhomogeneity of absolute ^{99m}Tc sestamibi uptake, it is quite possible that the best perfused region is in fact preserved in the spatially relative perfusion defect analysis.

In our study, the overall sensitivity of SPECT myocardial perfusion images for inducible ischemia in triple vessel disease was 100% (34/34), which is more than the results of several reports, the mean sensitivity increases for patients with TVD⁴⁻⁷.

Previous investigation has shown that the magnitude of ischemia has an exponential relationship to the occurrence of subsequent cardiac event⁸. Iskandrian et al. conducted a 2-year follow-up of 449 patients following the performance of ^{201}Tl myocardial perfusion scintigraphy⁹.

Brown and Rowen reported only two cardiac events during a mean follow-up of 24 months among 75 consecutive patients who manifested a normal exercise myocardial perfusion scintigraphy study in conjunction with angiographic evidence of significant CAD, yielding an annualized rate of cardiac event of only 0.7%/year¹⁰. The presence of a normal scintigraphic study confers a very benign prognosis, even in patients with strongly positive exercise electrocardiograms or angiographically significant CAD^{4, 10-12}. However, the numbers of this group might be underestimated because the widespread clinical acceptance of preferential selection of patients for CAG based on a positive myocardial perfusion imaging study result, and the refraining from catheterization of patients with a negative test result.

TID generally markers of both extensive and severe CAD^{13,14-18,19-21}. Hansen et al suggested that TID represent pathophysiologic responses to

exercise-induced ischemia²². TID represents transient subendocardial ischemia, in our study, TID was associated with 36 ischemic perfusion defects (56%), of which all 26 ischemic defects in LAD territory (100%) showed TID, 2 in LCX (18%) and 8 in RCA territory (33.3%). In this study, we found the presence of TID is most frequently associated with LAD territory ischemia than in any other coronary territory because of hemodynamic significance of LAD. The occurrence TID increases with increase in severity of stenosis on CAG.

Conclusion

This study showed that combined assessment of perfusion patterns and gated SPECT help in risk stratification. We have evaluated performance of TID for the detection of severe CAD. The results suggest that the TID ratios will provide incremental diagnostic & prognostic information to standard MPI study in semi quantitative analysis for the evaluation of patients with multi vessel CAD.

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