Original Article

Myocardial perfusion scintigraphy and coronary angiogram - A comparative study

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Abstract

Radionuclide myocardial perfusion imaging (MPI) can be used to demonstrate the presence of coronary heart disease and to risk stratify and guide management of patients with known disease. Aim of the study was to in risk stratifying the patients with CAD using MPI and coronary angiogram as gold standard. Primary objective is to correlate MPS findings with coronary angiogram in defining the global myocardial ischemia and secondary objective is to compare the sensitivity and specificity of MPS, taking CAG findings as the gold standard in patients in whom both tests are done. 63 patients were considered in the study. Most of the patients fell in moderate Dukes score (78 patients, 60%). 26 patients had abnormal MPI and 37 had normal MPI. Abnormal MPI showed good correlation (85-100%) with angiogram findings where as normal MPS correlation was less (75-90%) possibly due to good collateralization from other vessels. MPI has the ability to localize hemodynamically important coronary stenoses, and assess the extent and severity of coronary obstruction by the presence and extent of perfusion defects.

Key Word: Myocardial perfusion scintigraphy, Coronary angiogram and coronary artery disease.

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INTRODUCTION

Coronary Artery Disease (CAD) is the major concern for both developed and developing country as it is leading cause of mortality and morbidity. Risk stratification is critical for the management of the patient with known or suspected CAD. Decisions regarding treatment strategy can only be made after accurately identifying the patients who may benefit with the given treatment. There is constant demand that better methods be developed to diagnose IHD and to determine response to therapy since most deaths happen due to Ischemic Heart Disease (IHD) than any other disease demands.[1] Myocardial Ischemia is defined as "Diminished supply of blood in respect to cellular demands caused by coronary perfusion changes" by World Health task force.[2] This definition is used to describe any patient with IHD caused by CAD, with all other possible causes of ischemia placed in other category.

Myocardial Perfusion scintigraphy (MPS) is one such non invasive test which plays a very important role to risk stratifies the patients in suspected CAD. Regional abnormalities in myocardial perfusion occur in continuous spectrum from minor relative differences in flow, to full expression of myocardial ischemia with systolic and diastolic dysfunction. It is based on the occurrence of flow heterogeneity induced during stress in patients with suspected CAD. Hence the test has higher sensitivity (92%) and higher specificity (80%) compared to simple TMT.

Invasive Coronary Angiography (CAG) is at present considered as gold standard for diagnosing CAD. It is based on the extent of luminal narrowing with coronary atherosclerosis. Luminal narrowing of > 75% is considered as significant stenosis and revascularization is sought for. In cases of <75% stenosis the question still remains whether it is hemodynamically significant. Hence these patients undergo MPS stress-rest protocol, and intervention is done only in those patients who have positive MPS. Hence the above two tests MPS and CAG are interdependent in diagnosis and management of patients with CAD. Bayes's theorem states that reliability or interpreting a less than perfect diagnostic test not only

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depends on sensitivity and specificity of the test, but also depends on prevalence of the disease. Hence a clinical judgment is very important in interpretation of these diagnostic tests.

MATERIALS AND METHODS

Inclusion Criteria: All the patients with known and suspected CAD who underwent MPS and who were able to undergo Bruce Treadmill Test during the period between Jan 2007 to Aug 2007.

Exclusion Criteria: Patients with known history of Myocardial infarction and patients with abnormal baseline ECG (RBBB, Conduction block).

99mTc-MIBI-STRESS-REST MYOCARDIAL PERFUSION SPECT SCINTIGRAPHY

Myocardial SPECT Scintigraphy was performed with 99m-Tc sestamibi using of a single day " stress- rest " protocol according to ASNC guidelines.

Interpretation of the scan was done semi quantitatively by visual analysis assisted by circumferential profiles analysis using entegra software. Both exercise and resting tomographic views were reviewed side by side by experienced nuclear medicine physician. 17-segment model was used for reporting. An abnormal study was considered where there were reversible perfusion defects. A reversible perfusion defect was defined as perfusion defects on the exercise images that partially or completely resolved at rest in $\geq$ 2 contiguous segments in 17 segment model. Based on the degree of intensity and Summed Stress Score (SSS) reversible perfusion defects were divided into following

	SSS	Pattern/degree of uptake
1	0	Normal
2	1	Mildly reduced
3	2	Moderate-severely reduced

Abnormal MPS included all mild, moderate and severely reduced perfusion. Abnormal perfusion area (defect) was allocated to coronary artery territories according to the reference as described previously.[5]

CORONARY ANGIOGRAPHY

Invasive Coronary Angiography was done under local anesthesia in the cath lab. Under fluoroscope guidance, a tiny catheter advanced from the patient's groin or arm into the opening of the arteries. A small amount of radiographic contrast material was injected into each artery and x-ray was taken to reveal any blockages and their extent. All the standard views were taken and interpreted by two experiences cardiologists. The report included description of all the three vessels (LAD, LCX, RCA) and major branches with the extent of luminal narrowing expressed in percentages.

For the purposes statistical analysis and comparison with perfusion imaging, angiographic findings are classified into LAD, RCA and LCx territories.

- LAD and their branches supply anterior wall, septum and apical areas
- Lateral wall area is supplied by LCX, OM branches.
- Inferior wall area is supplied by RCA, PDA and PLV

RESULTS

Table 1: Findings in MPS

MPS	*Number (n=130)*	*%*
Normal	37	58.7
Abnormal	26	41.3

Table 2a: Correlation of Abnormal MPS with Angiogram findings

Comparison	True positive	False positive	False Negative	True negative	Total
MPS vs Angio (LAD)	9	2	1	14	26
MPS vs Angio (RCA)	13	0	2	11	26
MPS vs Angio (LCx)	6	1	1	18	26

Example: MPS vs Angio (LAD): 9 are MPS + and angiogram positive,
2 are MPS + but angiogram negative,
1 case is MPS negative but angiogram positive
14 patients both MPS and Angiogram normal

Table 2b: Correlation of Abnormal MPS with Angiogram findings

Comparison	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
MPS vs Angio (LAD)	90	87.5	81.8	93.3	88.4	<0.001**
MPS vs Angio (RCA)	86.6	100.0	100.0	84.6	92.3	<0.001**
MPS vs Angio (LCx)	85.7	94.7	85.7	94.7	92.3	<0.001**

Table 3: Correlation of Normal MPS with Angiogram findings

Comparison	Normal Angiogram	Abnormal Angiogram	Total	Correlation
LAD	28	9	37	75.6%
RCA	34	3	37	91.8%
LCx	28	9	37	75.6%

DISCUSSION

Myocardial Perfusion Scintigraphy and Invasive Coronary Angiography have both demonstrated significant power for diagnosing as well as to assess extent and severity of Coronary artery disease in both diagnosed and suspected patients. Soman and colleagues clearly showed the superior prognostic power of technetium-99m sestamibi, where normal scans were associated with an annual mortality of 0.2%.[3.] A. Yerramasu *et al*[4] showed that the severity of coronary stenosis was only a moderate surrogate among factors affecting myocardial blood perfusion, not sole decisive factor. Other factors affecting myocardial perfusion include length and shape of narrowing, eccentricity of plaque, and serial stenosis. Salm *et al*.[5] reported that MPI was normal in 50% of angiographically significant lesions. Particularly, lesions with an intermediate stenosis severity may have a great variability in hemodynamic significance.[6] Bekir *et al*[7], in their study aimed to compare MPS and CTCA based on conventional coronary angiography (CCA). Totally 60 patients were included in the study. CCA and MPS were performed to 30 patients; CCA and CTCA were performed to the rest of the patients (30 patients). Lesions were classified as mild, moderate and severe in these imaging methods. MPS and CTCA were compared with CCA by using chi-square and Fisher's exact test. MPS and CTCA's p values were found for left anterior descending artery (LAD) p: 0, p: 0.271; for circumflex artery (Cx) p: 0.256, p: 0.08 and for right coronary artery (RCA) p: 0.033, p: 0.271, respectively. Furthermore MPS and CTCA's sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated 81% to 87%; 70% to 49%; 73% to 72%; 54% to 72%; 90% to 71%, respectively. CCA results were found more concordant with MPS for LAD and RCA lesions and more concordant with CTCA for Cx lesions. It was also found that positive predictive value of MPS was significantly higher than the others. In our study there is good correlation of MPS with CAG findings. In the present study all the patients who had angiogram were divided into two categories viz. who had normal MPS and other who had abnormal MPS (Mild to severe defects). It is seen that patients with abnormal MPS correlated very well with CAG findings. Correlation of MPS in all the three-vessel territories in CAG was between 88 –93%, Sensitivity was as high as 85-90% and specificity was as high as 88-100%. However in the second group i.e, patients with normal MPS, the correlation with CAG was poorer compared with the previous one. It was between 75 –92%. Even though CAG showed >75% stenosis MPS was normal, thus hemodynamically significance of the stenosis can be assessed. Good collateralization from other territories explains the above findings.

LIMITATIONS

Since degree of stenosis assessed in CAG is operator dependent, inter observer variation is unavoidable.

CONCLUSION

Myocardial Perfusion Scintigraphy and Coronary Angiogram can be used independently and collectively for diagnosis and prognosis of the patients with Coronary Artery Disease. CAG providing anatomy of coronary vessels is considered as gold standard of diagnosing CAD. However hemodynamic significance of the stenosis need to be assessed at the myocardial level. In present study it shows that MPS findings correlates well with angiographic findings when the cut off is kept as >75% stenosis in their respective territories. It is also seen that few patients with significant stenosis in angiogram showed normal MPS, which can be explained by good collateralization from other vessels resulting in normal perfusion of the myocardium.

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