

## CLINICAL USEFULNESS OF Tc-99m HEXAKIS 2-METHOXYISOBUTYL ISONITRILE GATED SPECT IN PATIENTS WITH DILATED CARDIOMYOPATHY: RETROSPECTIVE ANALYSIS

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**Background:** In Dilated cardiomyopathy the heart is enlarged and ventricles are dilated. Gated myocardial perfusion single photon emission computed tomography is considered state of the art for myocardial perfusion imaging. A retrospective analysis was conducted to evaluate patients with dilated cardiomyopathy with Tc-99m sestamibi gated myocardial perfusion single photon emission computed tomography to evaluate its clinical utility. **Methods:** A 10 year retrospective medical record review was done from 1991 to 2001 at Wake Forest University, North Carolina, USA. Eligibility criteria included a diagnosis of dilated cardiomyopathy and availability of coronary angiography and Tc-99m sestamibi cardiac imaging results. 26 cases were selected for the final review and inclusion in the study. The study was done with standard protocols for cardiac sestamibi imaging. **Results:** A total of 26 cases were included in the final analysis. Cases were divided into two main groups. Group-A included 16 patients with no correlation between Tc-99m sestamibi and cardiac catheterisation reports. Group-B included 10 patients with good correlation between the above tests. There were no significant differences between the left ventricular ejection fraction, angina history, sex distribution and diabetic status between the two groups. We applied Wilcoxon Signed Rank Test and z-test to quantify the difference between the two groups. Data was tabulated and z-test was performed. The calculated *p*-value was <0.0001. This is significantly less than the tabulated *p*-value at 5% level of significance, i.e., 1.96. Significant differences exist between Group-A and Group-B. **Conclusion:** Tc-99m sestamibi is an excellent agent for investigating myocardial perfusion in dilated cardiomyopathy. The reversible and fixed perfusion defects (small to medium sized) seen in dilated cardiomyopathy after performance of Tc-99m sestamibi gated single photon emission computed tomography imaging may not be due to coronary artery disease. Tc-99m sestamibi single photon emission computed tomography is useful as a routine non-invasive technique to evaluate myocardial function in dilated cardiomyopathy.

**Keywords:** Gated single photon emission computed tomography, dilated cardiomyopathy, sestamibi, positron emission tomography

### INTRODUCTION

Dilated cardiomyopathy (DCM) is a heart muscle disease, in which the cardiac chambers become dilated and there is reduction of left ventricular function. Lifetime incidence is 36.5 cases per 100,000 persons.<sup>1</sup>

Patients with heart failure with no ischemic heart disease, hypertension, valve disease or congenital valve disease should be considered for DCM. It is the most common cardiomyopathy with multiple causes including idiopathic, toxins, familial, myocarditis (infective, autoimmune), peripartum, metabolic and nutritional.<sup>2</sup> The majority of cases are idiopathic.<sup>1</sup>

Diagnosis can be made with echocardiography or radionuclide ventriculography. In order to distinguish between hypertrophic or restrictive cardiomyopathy, pericardial disease or valvular disorders two dimensional and Doppler echocardiography is helpful. Endomyocardial biopsy is not routinely used and gives little information that can affect treatment of DCM.<sup>1</sup>

DCM and ischemic cardiomyopathy may be clinically indistinguishable. However the prognosis and management vary.<sup>3</sup> Selective angiography has

been traditionally employed for differentiation of these conditions. Among non-invasive techniques, echocardiography and magnetic resonance imaging diagnostically add little. Because of expense and limited availability positron emission tomography has limited use.<sup>4</sup>

Myocardial perfusion studies been done using thalium-201<sup>5-12</sup>, technetium-99m<sup>13</sup> and F-18 fluorodeoxyglucose<sup>4,14,15</sup> have shown that ischemic cardiomyopathy patients have more severe perfusion defects compared to patients with non-ischemic cardiomyopathy.

### MATERIAL AND METHODS

Patient records from 1991–2001 were reviewed. Patients' age range was 31–86 years. Eligibility criteria included a diagnosis of DCM and availability of coronary angiography and Tc-99m sestamibi cardiac imaging results. The patients did not have history of diabetes and had EF≤40%. A total of 26 cases were selected for the final review and inclusion in the study.

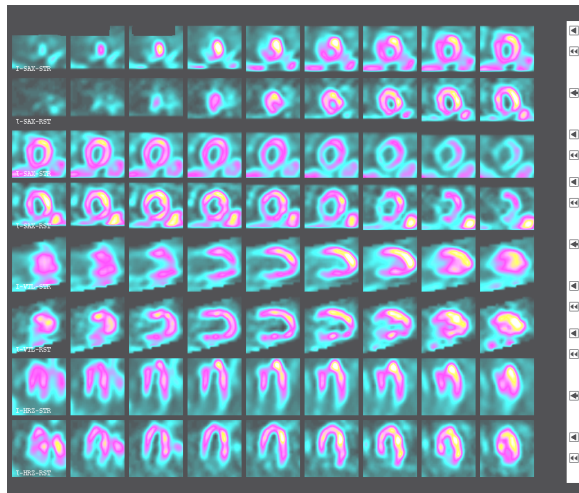
The study was done with 2 day protocol for all females weighing 250 lbs or more, and all males

weighing 300 lbs or more. For all other patients one-day protocol was used. Patients were kept NPO for at least 3 hours and resting images were performed 45 minutes after injection of 10 mCi (370 MBq) of Tc-99m sestamibi. Stress imaging was performed with treadmill or persantin with injection of 30 mCi (1110 MBq) of Tc-99m sestamibi and imaging done 15–30 minutes after exercise or 45 minutes after pharmacological stress. For two day protocol, stress and rest images were done on consecutive days with 25–30 mCi (925–1110 MBq) of Tc-99m sestamibi injection for each study.

**RESULTS**

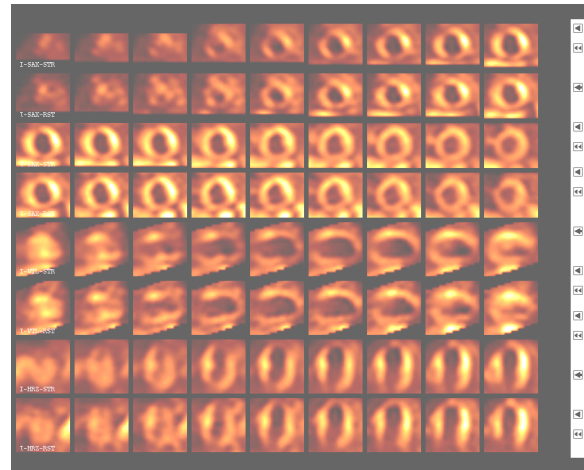
A total of 26 cases were included in the final analysis. Cases were divided into two main groups. First group assigned as Group-A (Figure-1), included 16 patients with no correlation between Tc-99m sestamibi and cardiac catheterisation reports. Second group assigned as Group-B (Figure-2), included 10 patients with good correlation between the above tests. There were no significant differences between the functional capacity, age/sex adjusted functional capacity, left ventricular ejection fraction, angina history, sex distribution and diabetic status between the two groups.

Statistical analysis was applied to quantify the difference between the two groups. We applied Wilcoxon Signed Rank Test and z-test to our data. Data was tabulated and z-test was used at 5% level of significance. A calculated *p*-value was <0.0001. This is significantly different from the tabulated *P*-value at 5% level of significance, i.e., 1.96. Hence it was deduced that significant differences exist between Group-A and Group-B.



**Figure-1: Tc-99m sestamibi Gated SPECT of patient with DCM**

Small reversible defect shown in the anteroseptal region extending to the apex with dilated left ventricle and global hypokinesia with EF of 36%. The patient had normal coronary arteries on angiography!



**Figure-2: Tc-99m sestamibi Gated SPECT of patient with ischemic heart disease**

Moderate sized infarct over the inferoapical wall shown without ischemia and a moderate sized anterior wall/anteroseptal region infarct with associated ischemia. Gated images showed global hypokinesia with EF of 18%. Coronary angiography showed LAD (proximal) 100%, 2<sup>nd</sup> marginal 90% and RCA 100% obstruction.

**DISCUSSION**

Tc-99m sestamibi is a lipophilic cation, member of isonitrile family. Chemical name is hexakis 2-methoxyisobutyl isonitrile. It was approved by FDA (food and drug administration) in 1990 for clinical use. Tc-99m sestamibi being lipid soluble diffuses from the blood into the mitochondria and retained there because of negative transmembrane potential. For practical purposes the tracer is fixed in the myocardium.<sup>16</sup>

Sometimes clinically one cannot distinguish dilated cardiomyopathy and ischemic cardiomyopathy and non-invasive ways (echocardiograph, MRI) add little. Traditionally selective angiography has been employed to distinguish these two conditions. Positron emission tomography is expensive and its availability is limited.<sup>3,4</sup>

Current state of the art for myocardial perfusion imaging is gated single photon emission computed tomography (GSPECT). In clinical practice it is the most common mode of data acquisition and display. It combines all information of myocardial perfusion scintigraphy in addition to regional and global left ventricular function data. Evaluation of wall motion and correlation with perfusion abnormalities is possible. GSPECT is possible with Tl-201 if mutidetector camera is used but Tc-99m labelled agents are preferable because of higher count statistic and better imaging characteristics for the gamma camera.<sup>17</sup>

Previously myocardial perfusion studies been done using Thallium-201,<sup>5-12</sup> Technetium-99m<sup>13</sup> and F-18 fluorodeoxyglucose<sup>4,14,15</sup> and have shown that ischemic cardiomyopathy patients have more

severe perfusion defects compared to patients with non-ischemic cardiomyopathy.

Comparing the results of our study to similar studies in the literature, Danias *et al*<sup>13</sup> showed myocardial perfusion imaging with Tc-99m sestamibi clearly separating patients with ischemic cardiomyopathy from non-ischemic cardiomyopathy. Summed stress, rest and reversibility scores and variability in segmental wall motion was significantly lower in non-ischemic cardiomyopathy compared to ischemic cardiomyopathy, i.e., summed stress defect score:  $6.9 \pm 3.8$  vs  $32.9 \pm 7.7$  respectively, and variance:  $0.3 \pm 0.3$  vs  $1.2 \pm 0.8$ , respectively, ( $p < 0.001$ ).<sup>13</sup>

Ragaisyte *et al*<sup>18</sup> showed that Tc-99m gated SPECT done at rest may be helpful in differentiating patients with global left ventricular systolic impairment and those with concomitant dilatation due to DCM or ischemic heart disease.

This study re-confirms the usefulness of performing GSPECT with Tc-99m sestamibi to evaluate non-invasively myocardial function in DCM and also distinguishing DCM from ischemic cardiomyopathy. Our results are consistent with similar studies in the literature.<sup>13,18</sup>

We believe that the reversible and fixed perfusion defects (small to medium sized) seen in DCM after performance of Tc-99m sestamibi GSPECT imaging are not due to coronary artery disease. As DCM histologically has non-specific features: Irregular atrophy and hypertrophy of the myocardial fibres with progressive fibrosis.<sup>19</sup> This can be one reason for the small to medium defects, and not due to myocardial perfusion insufficiency.

Another likely explanation is lower than normal wall thickness and not an excess in wall stress or tension. So partial-volume effects are likely to induce these abnormalities.<sup>20</sup>

The present study showed significant differences exist between Group-A and Group-B in spite of the limitations of inherent problems of retrospective data and small size population.

## CONCLUSION

The reversible and fixed perfusion defects (small to medium sized) seen in dilated cardiomyopathy after performance of Tc-99m sestamibi GSPECT imaging may not be due to coronary artery disease.

Tc-99m sestamibi GSPECT is an excellent and useful tool and may be used as a routine non-invasive technique to evaluate myocardial function in dilated cardiomyopathy.

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