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Dobutamine Tc-99m furifosmin SPECT in detection of coronary artery disease: Evaluation of same day, rest-stress protocol

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The purpose of this study was to evaluate the feasibility and diagnostic accuracy of same day rest-stress myocardial perfusion SPECT (MP SPECT) protocol by using technetium-99m (Tc-99m) furifosmin in conjunction with dobutamine stress test in subjects in whom coronary artery disease (CAD) had been proven or excluded at coronary angiography (CA).

The study group consisted of 25 patients (8 female and 17 male with a mean age of 53.04 ± 8.56 yrs) unable to perform treadmill exercise or unsuitable for pharmacologic vasodilator stress testing. Ten mCi (370 MBq) of Tc-99m furifosmin was injected intravenously at rest. Sixty min after injection, planar and SPECT images were acquired. One hour later all patients underwent dobutamine stress test. At the peak stress, 20 mCi (740 MBq) of Tc-99m furifosmin was injected. Sixty min after stress dose injection, planar and SPECT images were acquired. Rest-stress planar and SPECT data were evaluated by using visual and quantitative analysis. Heart to adjacent organ (Heart/Lung; H/Lu and Heart/Liver; H/Li) activity ratios were calculated from anterior planar images by using regions of interest (ROI). SPECT data were interpreted by using 20 segment-5 point scoring system from short axis and vertical long axis slices. The results of rest-dobutamine stress Tc-99m furifosmin MP SPECT were compared with CA results.

There were statistically significant differences between H/Lu and H/Li ratios at rest and stress conditions. Heart/adjacent organ activity ratios were similar and significant statistical difference could not be found between CA positive and CA normal patients.

Sensitivity, specificity and accuracy for Tc-99m furifosmin SPECT study were calculated as 90%, 80% and 84% for left anterior descending (LAD), 87%, 94% and 92% for left circumflex (LCx) and 67%, 86% and 80% for right coronary artery (RCA), respectively. Overall sensitivity, specificity and accuracy were calculated as 83%, 87% and 85%, respectively.

According to the results obtained in this study, it may be concluded that same day rest-dobutamine stress Tc-99m furifosmin SPECT protocol is a feasible and accurate technique in the evaluation of CAD, especially in patients unable to perform treadmill exercise or unsuitable for pharmacologic vasodilator stress testing.

Key words: Tc-99m furifosmin, dobutamine, myocardial perfusion SPECT, coronary artery disease

INTRODUCTION

MYOCARDIAL PERFUSION imaging plays an important role in the evaluation of CAD. Myocardial perfusion scintigraphy with thallium-201 (Tl-201) has been used for two decades to identify myocardial ischemia, infarction and viability. Although, Tl-201 has excellent physiological

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characteristics for perfusion and viability imaging, it has some physical limitations. In the course of time, new myocardial perfusion tracers labeled with Tc-99m were developed for myocardial perfusion imaging.[1–6] Among these tracers, Tc-99m furifosmin has been developed as an alternative to other myocardial perfusion imaging agents.[5,7,8] Tc-99m furifosmin is a member of non-reducible Technetium(III)-99m cationic complexes and shows good imaging properties. Proportional to regional myocardial perfusion, this tracer exhibits high uptake-rapid accumulation in the myocardium[8,9] and shows no evidence of myocardial redistribution[6,8,10,11] after intravenous administration. In addition, myocardial clearance of this compound is relatively slow, while background clearance is rapid.[8] The exact mechanisms of myocardial uptake, subcellular distribution and retention of Tc-99m furifosmin are not well understood,[10] but some investigators think that the cellular uptake of Tc-99m furifosmin may depend on negative transmembrane/mitochondrial potentials and cellular metabolic activity, similar to Tc-99m sestamibi and Tc-99m tetrofosmin.[12,13] According to Schomaecker et al., mitochondria and lysosomes were found to be principal retention site of Tc-99m furifosmin in tumor cells.[14] It was also reported that Tc-99m furifosmin might be sequestered in the mitochondria similar to Tc-99m sestamibi.[15]

Dobutamine is a synthetic sympathomimetic amine (β-1, β-2, and α-1 adrenoceptor agonist) that has positive potent inotropic and chronotropic effects. Dobutamine has inotropic effects at lower doses without a major effect on heart rate. It becomes a positive chronotropic agent at higher doses. Dobutamine increases oxygen consumption of myocardium by increasing heart rate, contractility and arterial blood pressure and produces similar hemodynamic effects as physiological exercise. Dobutamine is used as a pharmacological stress agent in conjunction with myocardial perfusion imaging and echocardiography.[16–20]

This study was designed to assess the feasibility and diagnostic accuracy of Tc-99m furifosmin same day rest-stress SPECT protocol in conjunction with dobutamine infusion for the detection of suspected or known CAD in patients unable to perform treadmill exercise or unsuitable for pharmacologic vasodilator stress.

All patients underwent CA and our results were compared with CA results.

MATERIAL AND METHOD

Patient Population: The study group consisted of 25 patients [8 female (32%) and 17 male (68%) with a mean age of 53.04 ± 8.56 years, range 38 to 70] who were referred to Gazi University Hospital, Dept. of Nuclear Medicine for myocardial perfusion SPECT (Table 1). Five patients had severe orthopedic problems, 20 patients had mild physical problems (3 of 20 also had a history of chronic obstructive pulmonary disease or bronchospasm with exercise and other 3 of 20 patients had also low systolic blood pressure) which limited them to perform treadmill exercise or pharmacologic vasodilator stress testing.

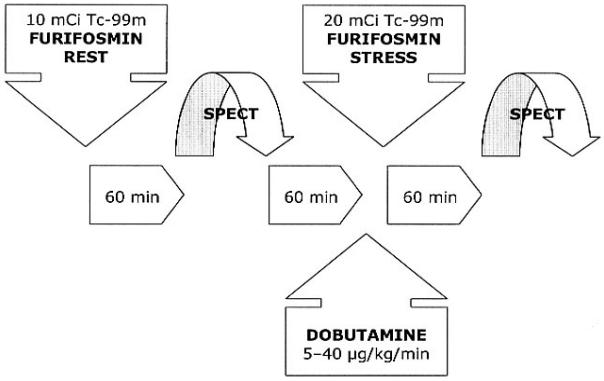

Fig. 1 Schematic representation of Tc-99m furifosmin rest-dobutamine stress protocol. Total time, approximately 3½ hrs.

Fourteen of the 25 patients (56%) had no previous myocardial infarction, whereas 11 (44%) of the study group had historical and/or electrocardiographic (ECG) criteria for prior myocardial infarction. None of the patients had undergone previous percutaneous transluminal coronary angioplasty and/or coronary artery bypass grafting surgery.

Patients with stable myocardial infarction or a history of typical angina or angina-like chest pain were included to this study.

Exclusion criteria were unstable diseases such as recent infarction (< 2 mo old) or angina, or associated problems such as congestive heart failure, cardiomyopathy, significant valvular heart disease and left bundle branch block. Radionuclide studies were performed 48 hrs after withdrawal of β-adrenergic blocking agents and calcium antagonists. Prior to the study, details were explained to each patient individually by the physician. All patients gave informed consent before testing. This study protocol was based on the regulations of the hospital ethical committee.

Coronary Angiography: All patients underwent CA using standard percutaneous techniques within 2 weeks of the radionuclide studies. Coronary stenosis was visually assessed from multiple projections by at least two experienced cardiologists without knowledge of the furifosmin SPECT results and expressed as percent lumen diameter stenosis. Significant coronary artery stenosis was considered as ≥50% luminal narrowing in major coronary vessels.

Radiopharmaceutical Preparation: Tc-99m furifosmin was prepared from TechneScan® Q12 kit (Mallinckrodt Med. Inc.) by reconstitution with sterile, non-pyrogenic sodium pertechnetate solution (1.85–9.3 GBq) in approximately 2–3 m*l*. The content of the vial

was boiled for 15 minutes. After this process, the vial was allowed to cool to room temperature. Radiochemical purity was determined by paper chromatography and only doses with ≥90% labeling were used within six hours of preparation.[21]

Study Design: This study was designed as a same day rest-stress myocardial SPECT imaging protocol.[22–24] Ten mCi (370 MBq) of Tc-99m furifosmin was injected intravenously at rest conditions. Sixty minutes later, rest cardiac SPECT imaging was performed. After one hour waiting period, 20 mCi (740 MBq) of Tc-99m furifosmin was administered at peak stress following dobutamine infusion. Sixty minutes after the injection stress cardiac SPECT imaging was performed (Fig. 1).

Dobutamine Stress: Sixty min after the rest SPECT imaging, patients underwent a dobutamine stress test. The patient was placed supine on a standard examination table and a well functioning peripheral intravenous line was established. The extension set connected to the three way stopcock was attached to an infusion pump system. Dobutamine was administered intravenously at incremental doses of 5, 10, 15, 20, 25, 30 and 40 μg/kg per min at 3 min intervals.

Systolic and diastolic blood pressure, heart rate and 12 lead ECG were recorded every 3 min during infusion and until the heart rate returned to <100 beats per min and all symptoms disappeared.[17,18,25]

Criteria for termination of dobutamine infusion were: (1) Angina or chest discomfort; (2) Significant arrhythmia; (3) Severe hypertension (systolic blood pressure ≥220 mmHg or diastolic blood pressure ≥110 mmHg or both); (4) Decrease of the systolic blood pressure (20 mmHg or more); (5) Heart rate of more than 85% of the predicted heart rate; (6) Maximal dobutamine infusion dose rate (40 μg/kg/min); (7) Significant ST segment depression on ECG (≥2 mm).[18,25–27]

At the maximum tolerated dose of dobutamine, 20 mCi (740 MBq) of Tc-99m furifosmin was injected intravenously and dobutamine infusion was continued for an additional 1 min.

SPECT Acquisition and Processing: SPECT imaging was performed using a dual head gamma camera (General Electric OPTIMA®, USA) equipped with low energy high resolution parallel hole collimators and connected with a dedicated computer system. For image acquisition a peak energy setting at 140 keV with a 20% window was used. SPECT images were obtained with a circular orbit over a 180° arc, starting from 45° right anterior oblique projection and ending at the 45° left posterior oblique projection. Each of 64 projections were acquired with a 64 × 64 matrix for 25 sec/projection for rest and 20 sec/projection for stress imaging using the 'step & shoot' technique. SPECT data were stored in Starcam 4000i computer and tomographic reconstructions were obtained with filtered back projection. Images were processed using Ramp and Butterworth filters. Reconstructed tomographic slices were reoriented in the short, horizontal long and vertical long axes of the left ventricle for visual image interpretation. Polar map representations of short axis slices were also displayed.

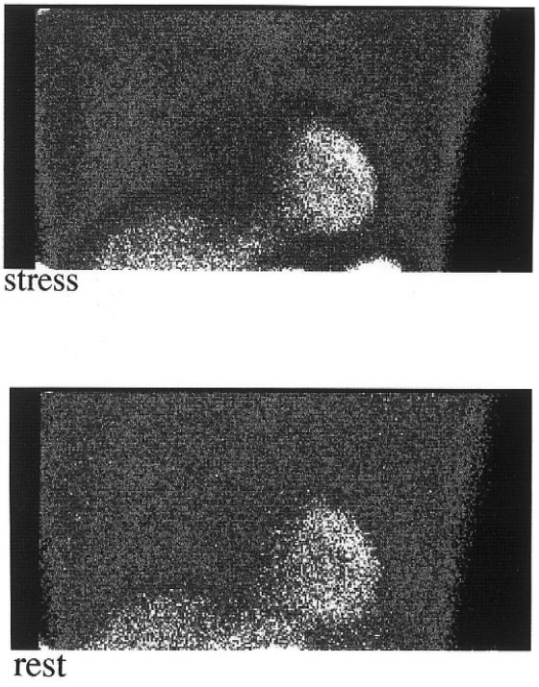

Fig. 2 Stress and rest anterior planar images for a patient with normal coronary angiography.

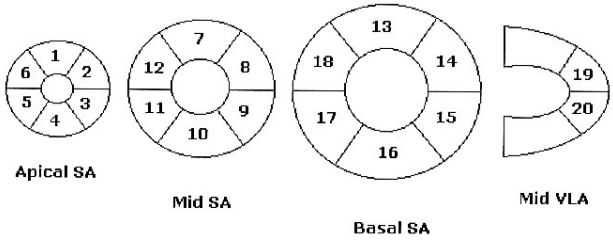

Fig. 3 Schematic representation of 20 segment-5 point scoring system of apical-mid-basal short axis and vertical slices.[28–30]

Planar Image Analysis: Before SPECT imaging anterior planar images which included thorax and upper abdomen were obtained for 5 min with a 256 × 256 matrix in all patients (Fig. 2). H/Lu and H/Li activity ratios were calculated from anterior planar images by using regions of interest (ROIs). The average counts per pixel of the box ROIs placed over liver and right lung and irregular ROIs placed over left ventricle of the heart in the anterior static images were used for calculating H/Lu and H/Li activity ratios. The values of these ratios that obtained both rest and stress conditions for all patients were then statistically analyzed. All ROI placements were done by the same physician for all patients.

Tomographic Image Analysis: Rest and stress SPECT tomographic slices were analyzed from apical-mid-basal

Table 1 Clinical data and Tc-99m furifosmin—dobutamine stress test results

Patient No.	Age (yrs)	Gender	MI	Coronary Angiography			Dobutamine Stress		
				LAD (%)	LCx (%)	RCA (%)	Dose Rate (μg/kg/min)	Time (min)	ECG Changes
1	56	M	–	–	70–50	70	15	12	–
2	60	M	Inf	70	–	Occ	25	10	IVPB + ST
3	51	F	–	30–40	–	–	15	12	–
4	51	M	Ant, AS	95	–	–	10	15	IVPB
5	47	M	Inf	80	–	90	15	10	IVPB
6	48	M	–	30–40	–	60	20	13	–
7	63	M	Ant	Occ	90	95	15	16	FVPB
8	50	M	–	–	–	70	20	16	–
9	54	F	Inf	–	–	Occ	15	11	ST
10	45	F	–	50	80	–	20	14	–
11	46	M	–	98	–	–	20	11	ST
12	54	M	AS	60	80–60	–	20	11	IVPB + ST
13	65	F	–	–	–	Occ	20	11	ST
14	52	M	Inf	–	Occ	–	20	21	–
15	45	M	AS	80	50	–	20	21	IVPB
16	48	M	–	–	50	80	15	8	ST
17	54	F	–	–	–	60	20	13	–
18	40	M	Inf	–	60	70	15	10	–
19	51	M	Ant	Occ	–	–	20	14	VPB
20	68	F	Ant	Occ	–	–	20	11	IVPB
21	38	F	–	–	–	–	15	11	–
22	46	M	–	–	–	–	15	11	–
23	70	M	–	–	–	–	15	13	–
24	67	F	–	–	–	–	15	9	–
25	57	M	–	–	–	–	20	16	IVPB
Mean age: 53.04 ± 8.56 yrs				10	8	11	17.6 ± 3.27	12.8 ± 3.28	
				(Lesions ≥ 50%)					

MI, myocardial infarction; LAD, left anterior descending artery; LCx, left circumflex artery; RCA, right coronary artery; Ant, anterior; Inf, inferior; AS, anteroseptal; Occ, occlusion; IVPB, isolated ventricular premature beat; FVPB, frequent ventricular premature beat; ST, ST segment change less than 2 mm

short axis and apical vertical slices by using 20 segment, 5 point scoring system (0: normal uptake, 1: mildly reduced, 2: moderately reduced, 3: severely reduced, and 4: absent uptake; and 0–1 scores were considered normal, 2–4 scores were considered abnormal)[28–30] (Fig. 3). According to the segment scores, each region of coronary vessels on the stress slices were determined to be normal or abnormal. An abnormal region was defined as reversible if the change in regional activity at rest imaging. Regions were then interpreted as normal perfusion, stress induced perfusion defect, or fixed perfusion defect.

Data were interpreted by two experienced observers independently without prior knowledge of clinical history or CA results of patients. Any differences in interpretation were resolved by reaching consensus agreement in case of contradictory segmental evaluation.

Statistical Analysis: The sensitivity, specificity and accuracy of dobutamine stress Tc-99m furifosmin myocardial perfusion SPECT were obtained in the usual fashion. Patient demographic data, hemodynamic data and heart to adjacent organ (H/Lu, H/Li) activity ratios were presented as mean ± SD. Paired t-Test was used to analyze hemodynamic variables and H/Lu, H/Li activity ratios. H/Lu and H/Li activity ratios were also analyzed with Mann-Whitney U Test for CA positive and CA normal patients for stress and rest conditions.

A p value < 0.05 was considered statistically significant.

RESULTS

Coronary Angiography: All coronary angiograms were interpreted separately by two cardiologists. A vessel displaying ≥50% luminal stenosis was considered significant. Nineteen patients had significant stenoses and 1 patient had non-significant stenosis. In 1 patient (4%) three coronary vessels were diseased; 9 patients (36%) had two-vessel diseases, 10 patients (40%) had single vessel disease and 5 patients (20%) had normal CA.

According to the results of CA, affected vascular terri-

Table 2 Results of Tc-99m furifosmin SPECT studies; sensitivity, specificity, accuracy, positive and negative predictive values according to the results of CA (stenosis degree ≥ 50%)

	LAD (n = 10)	LCx (n = 8)	RCA (n = 11)	Overall (n = 29)
Sensitivity (%)	90	87	67	83
Specificity (%)	80	94	86	87
Accuracy (%)	84	92	80	85
PPV (%)	75	87	80	80
NPV (%)	92	94	80	89

tories (luminal stenosis ≥ 50%) comprised 10 lesions of the left anterior descending (LAD) artery territory, 8 lesions of the left circumflex (LCx) artery territory and 11 lesions of the right coronary artery (RCA) territory in 25 patients. All patients' clinical and angiographic data are summarized in Table 1.

Dobutamine Stress: The main effect of dobutamine is an increase in myocardial oxygen demand. In the overall group, dobutamine significantly increased the heart rate from 71.4 ± 13.7 beats/min to 129.2 ± 12.5 beats/min ($p < 0.001$). The mean systolic blood pressure significantly increased from 133.40 ± 25.68 to 163.40 ± 28.89 mmHg ($p < 0.001$). The mean diastolic blood pressure significantly decreased from 82.80 ± 10.61 at rest to 76.40 ± 11.13 mmHg at peak stress ($p < 0.005$). Mean dobutamine dose was 17.62 ± 3.27 μg/kg/min, and mean dobutamine time was 12.80 ± 3.28 min. Peak Double Product was calculated as 172.50 ± 40.90. The highest dobutamine dose was 10 μg/kg/min in 4% of the patients, 15 μg/kg/min in 44% of the patients, 20 μg/kg/min in 48% of the patients, and 25 μg/kg/min in 4% of the patients. In this study group, after dobutamine infusion all side effects were mild and transient and reversed rapidly after termination of the dobutamine infusion. Most frequent side effect was sense of palpitation during dobutamine infusion, which resolved within several minutes after termination of the infusion [in 18 of 25 pts (72%)]. Mild ventricular arrhythmias i.e., isolated ventricular premature beats, occurred in 8 of 25 pts (32%) during dobutamine infusion. Frequent ventricular premature beats were occurred in 1 patient (4%). Horizontal ST-segment changes of less than 2 mm was found in 6 patients (24%) after dobutamine infusion. None of the patients experienced MI or ventricular fibrillation at peak dobutamine infusion. None of the patients demonstrated nausea and significant headache. Dobutamine infusions were ended at 15 μg/kg/min dose rate in two patients. One of them demonstrated severe hypertension (260/110 mmHg) and the other patient demonstrated frequent ventricular premature beats during dobutamine infusion.

Tc-99m Furifosmin Planar Images: H/Lu activity ratios were calculated as 2.27 ± 0.28 for rest and 2.16 ± 0.29 for stress conditions. H/Li activity ratios were calculated as 1.19 ± 0.26 for rest and 1.27 ± 0.21 for stress conditions. There was statistically significant differences between H/Lu ($p < 0.05$) and H/Li ($p < 0.05$) ratios at rest and stress conditions.

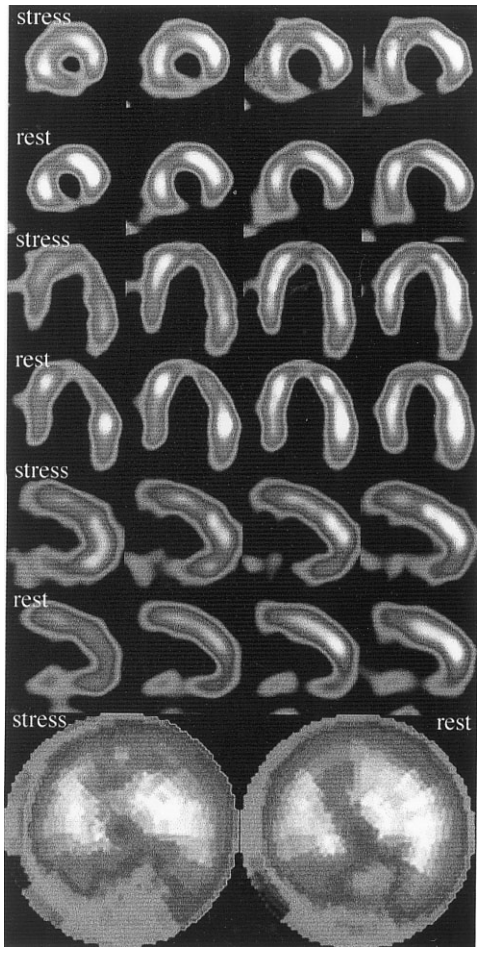

Fig. 4 A case example: Apex and anterior hipoperfusion, and inferior perfusion defect at stress study after dobutamine infusion, no significant reversibility at inferior wall at rest study (Patient no. 5, 47 yrs, male, inferior MI (+), LAD 80%, RCA 90% lesions, 15 μg/kg/min, and 10 min dobutamine infusion).

H/Lu activity ratios were 2.24 ± 0.26 at rest, 2.18 ± 0.31 at stress for CA positive patients and 2.36 ± 0.37 at rest, 2.06 ± 0.22 at stress for CA normal patients. H/Li activity ratios were 1.16 ± 0.26 at rest, 1.29 ± 0.22 at stress for CA positive patients and 1.31 ± 0.23 at rest, 1.22 ± 0.17 at stress for CA normal patients.

There was no statistically significant differences between CA positive and CA normal patients for H/Lu ($p > 0.05$) and H/Li ($p > 0.05$) activity ratios at rest and stress conditions according to Mann-Whitney U Test.

Tc-99m Furifosmin SPECT: Good quality images were obtained for all patients in this study protocol. Normal myocardial perfusion was seen in 60% of whole coronary vessel regions which have been interpreted. According to the results of segmental analysis, abnormal perfusion (perfusion defect) was found in 40% of

coronary vessel regions at stress studies. Reversibility was not found in 29% of these defects at rest studies (Fixed perfusion defect). Fixed perfusion defects for LAD, LCx and RCA regions were 13%, 3%, and 13%, respectively. On the other hand, perfusion change was found in 11% of stress perfusion defects at rest studies. Complete filling was found in 52% at rest study (complete filling for LAD, LCx and RCA regions were 19%, 19%, and 14%, respectively) while, partially filling was found in 48% at rest study (partially filling for LAD, LCx and RCA territory were 19%, 14%, and 15%, respectively) of these defects which perfusion change has been seen.

Nineteen patients had significant (≥50% diameter) coronary artery stenoses; 24 of 29 (83%) coronary artery stenoses were identified by Tc-99m furifosmin SPECT study. Overall sensitivity was 83%, specificity was 87%, and accuracy was 85%. For the LAD territory, a sensitivity of 90%, a specificity of 80% and an accuracy of 84% were shown in this protocol. For the LCx, the results were 87%, 94%, and 92% respectively; for the RCA they were 67%, 86%, and 80% respectively.

Case examples of Tc-99m furifosmin SPECT study showing inferior fixed defect and partially reversibility at apex and anterior walls on both tomographic slices and polar map representations were illustrated in Figure 4. Comparison of the results of same day rest-dobutamine stress Tc-99m furifosmin SPECT protocol according to the results of CA was summarized in Table 2.

DISCUSSION

Evaluation of myocardial perfusion has great importance in the diagnosis and treatment of patients with known or suspected CAD. In recent years, several of Tc-99m labeled myocardial perfusion imaging tracers have been developed for clinical use such as Tc-99m tetrofosmin and Tc-99m furifosmin. These new radiopharmaceuticals have some attractive imaging properties (i.e. long myocardial retention and no significant redistribution over time) for the evaluation of CAD in clinical nuclear cardiology practice.[3,5,7,8,11,22,24,31] Tc-99m furifosmin is a cationic lipofilic myocardial perfusion imaging tracer having promising results in preliminary studies and potential advantages over other myocardial tracers. Previous studies demonstrated that after i.v. administration, Tc-99m furifosmin is rapidly cleared from blood and accumulated in the myocardium.[9,32] As mentioned by Rossetti et al. Tc-99m furifosmin shows good heart uptake (2.2%, % injected dose at rest, 1 hr postinjection) with no significant myocardial washout or redistribution up to 5 hr postinjection, and clears rapidly from hepatobiliary system. According to Rossetti et al., Tc-99m furifosmin combines the relatively high myocardial uptake and prolonged myocardial retention of Tc-99m sestamibi with the relatively rapid hepatobiliary clearance of Tc-99m tetrofosmin.[8] After injection of Tc-99m furifosmin in patients and normal volunteers no significant changes in heart/organ ratios were concluded by Daher et al.[32] On the other hand, there are few clinical data available in the literature directly comparing the Tc-99m perfusion tracers for the detection of CAD.[11] According to the recent results obtained by Matsunari et al., in spite of late redistribution and slow hepatic clearance but long myocardial retention characteristics, Tc-99m sestamibi may display more favorable characteristics as a flow tracer compared with Tc-99m tetrofosmin or Tc-99m Q12 in the porcine model.[11]

Average H/Lu and H/Li activity ratios obtained herein for Tc-99m furifosmin were H/Lu: 2.27 ± 0.28 for rest and 2.16 ± 0.29 for stress conditions and, H/Li: 1.19 ± 0.26 for rest and 1.27 ± 0.21 for stress conditions (at 60 min postinjection). A comparison of the average H/Lu and H/Li ratios obtained herein for Tc-99m furifosmin to literature data; H/Lu activity ratios were significantly higher than that reported in the literature (2.27 ± 0.28 versus 1.57 ± 0.46 for rest, 2.16 ± 0.29 versus 1.73 ± 0.29 for stress, 60 min postinjection) whereas, H/Li activity ratios were lower than that reported in the literature (1.19 ± 0.26 versus 1.40 ± 0.46 for rest and 1.27 ± 0.21 versus 1.65 ± 0.33 for stress, 60 min postinjection).[8] The average H/Lu ratios for rest conditions obtained in this study were significantly higher as compared to Tc-99m furifosmin and Tc-99m sestamibi results in literature (2.27 ± 0.28 versus 1.56 ± 0.191 for Q12 and 1.94 ± 0.197 for sestamibi, 60 min postinjection).[33] When we compare the average activity ratios obtained in this study to Tc-99m tetrofosmin activity ratios in the literature, similarity was found between the results of Tc-99m furifosmin and Tc-99m tetrofosmin for 60 min postinjection.[3]

Because of desirable imaging properties (high myocardial uptake and retention in association with rapid blood and liver clearance), Tc-99m furifosmin has been chosen for the myocardial perfusion agent in this study. The purpose of this study was to evaluate the feasibility and diagnostic accuracy of same day rest-stress myocardial perfusion SPECT protocol by using Tc-99m furifosmin in conjunction with dobutamine stress test in subjects whose coronary artery disease had been proven or excluded at coronary angiography. Dobutamine has both positive chronotropic and inotropic effects as a predominant β-1 receptor agonist and it causes dose dependent increment in heart rate and systolic blood pressure, while decreasing diastolic blood pressure. According to these hemodynamic effects of dobutamine; it causes regional coronary blood flow alterations due to increased myocardial oxygen demands and alterations of coronary flow reserve.[18,25] In the present study, because of favorable properties (safety, feasibility and patient tolerance), dobutamine pharmacologic stress for non-invasive detection of CAD was used for stress testing. Sufficient cardiac stress was obtained by inducing significant increases in heart rate and systolic blood pressure without occurrence of major

adverse effects with a dose of 17.62 ± 3.27 μg/kg/min dobutamine infusion and at the time of 12.80 ± 3.28 min.

Dobutamine infusion has been reported as a valuable alternative stress method in conjunction with myocardial perfusion imaging with good sensitivity and specificity results compared to those achieved during exercise or with dipyridamole and adenosine.[18,20,25,34,35]

To our knowledge, although few experimental data are available on the use of dobutamine with Tc-99m furifosmin in animals,[19] no data are yet available for dobutamine pharmacological stress testing with Tc-99m furifosmin SPECT imaging in patients.

We thought that dobutamine infusion allows detection of CAD with high diagnostic accuracy when dobutamine pharmacologic stress test is combined with rest-stress imaging protocol. The rest-stress protocol sequence was chosen for this study since the same day imaging protocol using a low dose rest study followed by a high dose stress study allows Tc-99m imaging with cationic complexes to be completed within a few hours. The rest-stress sequence allows the higher dose to be given during exercise. Both real rest imaging on the rest study and the imaging of the high dose on the stress study give optimal imaging of stress induced defects and is reported to improve detection of reversibility compared with the stress-rest sequence.[36] A short waiting period was applied between rest and stress studies in all patients. We thought that, application of rest SPECT study first with low dose and then short waiting period between rest and stress studies could reduce the undesirable high intensive activity, and could prevent the misinterpretations especially in evaluation of inferior wall.

Total study time was calculated as approximately 3½ hours (Fig. 1).

In the present study, we demonstrated the ability of dobutamine Tc-99m furifosmin myocardial perfusion SPECT in the detection of CAD. Our data demonstrate that, dobutamine stress Tc-99m furifosmin SPECT is highly sensitive (83%) in the overall detection of coronary artery disease. The specificity was also good (87%) in the limited number of patients with normal CA.

This study has several noteworthy limitations. First, the number of patients included in this study was relatively small. Compared to the previous studies, the high sensitivity and specificity in our study can be explained by the small number of patients (n = 25) and 11 (44%) of the patients having a history of prior myocardial infarction (3 of 11 pts also having aneurysm). In addition to this, using dobutamine combined with imaging protocol which effectively induced ischemia, caused by increased cardiac work and augmented coronary flow may also be a reason of the high sensitivity and specificity. Another limitation of this study is that, although it is known that Tc-99m furifosmin has been developed as an alternative agent to other myocardial perfusion tracers to evaluate myocardial perfusion and CAD, there is no comparable Tc-99m furifosmin MP SPECT study in conjunction with dobutamine on patients and there is no directly head-to-head comparison study done with other radiopharmaceuticals in conjunction with dobutamine on patients in literature.

Further clinical studies with a larger number of patients are required for the determination of exact role of dobutamine Tc-99m furifosmin myocardial perfusion SPECT in the diagnosis of myocardial perfusion abnormalities in patients with suspected or known CAD. We believe that in patients without prior MI history and/or findings, applying new studies in which head-to-head comparison between other pharmacological stress tests with same day rest-dobutamine stress in conjunction with Tc-99m furifosmin can be useful.

CONCLUSION

When compared to CA results, same day rest-stress Tc-99m furifosmin protocol offers a sensitive and effective technique in the detection of CAD.

According to the results obtained in this study, it is concluded that by applying dobutamine stress in conjunction with Tc-99m furifosmin same day, rest-stress SPECT protocol appears to be an accurate and favorable technique for the evaluation of CAD in patients who are unable to perform treadmill exercise or unsuitable for pharmacologic vasodilator stress. When there is a requirement for an increase in patient throughput and efficient camera use in busy nuclear medicine department, because of the relatively short waiting period between rest and stress studies, this protocol becomes advantageous.

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