

POSTER SESSION V
Saturday, September 13, 2008, 2:30 p.m. – 4:00 p.m.
Diagnosis and Risk Stratification

35.20

IMPAIRED VASCULAR FUNCTION MEASURED BY FINGERTIP THERMAL MONITORING PREDICTS MYOCARDIAL PERFUSION DEFECT

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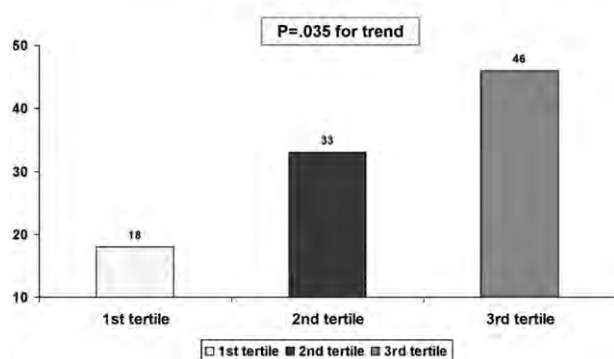
Background: Coronary endothelial dysfunction has been postulated as a potential mechanism of myocardial perfusion defect (MPD) seen on myocardial perfusion imaging (MPI). Previous studies have shown that vascular reactivity measured by Digital Thermal Monitoring (DTM) during an arm-cuff reactive hyperemia procedure correlates with the severity of coronary artery disease measured by coronary calcium score. This study investigates whether DTM correlates with MPI independent of traditional risk factors measured by Framingham Risk Score (FRS).

Methods: One hundred sixteen patients with chest discomfort, age 57 ± 10 years, 55.2% female, underwent MPI and DTM. Vascular endothelial function was assessed by DTM after a 2-minute supra systolic arm cuff occlusion test. Post-cuff deflation temperature rebound (TR%) and Area Under the Curve (TAP AUC) were studied as indices of vascular reactivity.

Results: TR% was significantly lower in patients with MPD compared with normal (0.36 ± 0.14 vs. 1.02 ± 0.37 , $p=0.01$). After adjusting for traditional risk factors, the odds ratio for presence of MPD among those with lowest tertile of TR% vs. upper tertile was 4.50 (95%CI 1.40-14.48, $p=0.012$). Addition of TR% to FRS increased the area under the receiver operator characteristic curve to predict MPD from 0.67 to 0.74 ($p<0.05$).

Conclusions: Vascular dysfunction measured by DTM is associated with MPD independent of risk factors. Combination of DTM and FRS provides maximum predictive value. This study suggests potential utility of DTM for improving cardiovascular risk assessment.

Myocardial Perfusion Abnormality (%)
According to TR% Tertiles Cutoffs



35.21

ELEVATED SERUM CREATININE IS INDEPENDENTLY ASSOCIATED WITH ABNORMAL STRESS MYOCARDIAL PERFUSION IMAGING IN MALES PRESENTING TO THE EMERGENCY DEPARTMENT WITH CHEST PAIN

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Background: Conventional coronary artery disease (CAD) risk indicators do not fully predict CAD, and additional CAD indicators may optimize risk stratification. Our objective was to assess the value of serum creatinine (SCR) as a marker of CAD as defined by abnormal myocardial perfusion imaging (MPI)

in patients presenting to the emergency department (ED) with chest pain (CP), non-diagnostic electrocardiogram, and normal troponin levels.

Methods: We studied 176 males and 237 females (mean age of 58 ± 13 yrs.) presenting to the ED with CP, normal ECG tracings, and normal troponin levels. We included patients with a SCR cut-off value of ≥ 1.1 mg/dl for men and ≥ 0.9 mg/dl for women. All these patients underwent stress MPI within 12 to 48 hours of presenting to the ED. Patients with a prior history of CAD and a SCR of > 3 mg/dL were excluded.

Results: Out of 176 males, 73 (mean age 60 ± 13 yrs.) had a SCR ≥ 1.1 mg/dl and 103 males (mean age 53 ± 13 yrs.) had a SCR < 1.1 mg/dl. Out of the 73 males with a SCR ≥ 1.1 mg/dl, 52% had abnormal MPI and 25% of the 103 males with < 1.1 mg/dl had abnormal MPI ($p<0.001$). There was a sensitivity of 63% and specificity of 73% with a positive predictive value of 62% and a negative predictive value of 75% respectively. Of the females with SCR of > 0.9 mg/dl, 19% had abnormal MPI and of the females with SCR of < 0.9 mg/dl, 17% had abnormal MPI ($p=NS$). In a multivariate model, adjusted for CAD risk indicators, SCR was independently associated with abnormal MPI.

Conclusions: The independent association between a SCR of ≥ 1.1 mg/dl in male patients and abnormal stress MPI suggests that SCR of > 1.1 has additional value to conventional risk indicators in predicting CAD in males presenting to the ED with CP and with normal cardiac biomarkers and non-diagnostic ECG. The assessment of SCR can be useful in identifying those at increased risk for CAD at an early stage.

Variables	Odds ratio	P value
Male SCR ≥ 1.1 mg/dl	3.54	0.0003
Female SCR ≥ 0.9 mg/dl	0.82	0.58
Age	1.05	0.0001
HTN	2.27	0.04
DM	1.57	0.11
Chol	0.94	0.82
SMK	1.38	0.25
FHx	1.17	0.61

35.22

VALUE OF MYOCARDIAL PERFUSION IMAGING IN INTERMEDIATE-RISK EGYPTIAN WOMEN

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Background: Angina in women is a clinical dilemma. Typical angina symptoms are considered the cornerstone for suspecting coronary artery disease (CAD) by many clinicians. However, chest pain in women is frequently not "typical" and can lead to mis-diagnosis. Although myocardial perfusion imaging (MPI) has a higher degree of sensitivity and specificity especially in females, it is 7 times more expensive than exercise stress test (ET) in our country. We sought to study the value and cost effectiveness of the ET versus MPI results in evaluating ischemia in intermediate risk women with normal resting electrocardiograms.

Methods: This study included 500 consecutive female patients referred for a diagnostic MPI between June 2006 and December 2007. ET was done using standard Bruce protocol and was considered positive if ST depression of > 0.5 down-sloping or > 1 mm horizontal or > 1.5 mm up-sloping. MPI was done using stress/rest Thallium-201 single-photon emission computed tomography. Images were analyzed using 20-segment 5-point scale (0 = normal to 4 = no uptake) and summed stress scores (SSS), summed rest scores (SRS), and summed difference scores (SDS) were then calculated. MPI was considered positive when $SSS > 3$.

Results: Of the 500 patients, the mean age was 51.4 ± 8.3 with a mean number of risk factors 1.2 ± 0.9 . In all, 36.8% had diabetes, 62.8% had hypertension, 24.6% were smokers, and 38.6% had hyperlipidemia. Overall, 240 female patients (48.2%) had a positive ET and 390 female patients (74.3%) had a positive MPS with a mean SSS of 7.4 ± 5.1 , a mean SDS of 4.9 ± 3.7 , and a mean SRS of 2.4 ± 3.3 .

Conclusions: MPI is more accurate than ET alone and is probably cost effective for the initial evaluation of CAD in intermediate pre-test likelihood females.

35.23

INCREMENTAL PROGNOSTIC VALUE OF EJECTION FRACTION BY ECG-GATED MYOCARDIAL PERFUSION SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY FOR THE PREDICTION OF FUTURE ACUTE CORONARY SYNDROME IN JAPANESE POPULATION

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Background: The prognostic value of electrocardiogram (ECG)-gated rest ²⁰¹Tl/ stress ^{99m}Tc-tetrofosmin dual-isotope myocardial perfusion single-photon emission computed tomography (SPECT) for the prediction of future hard cardiac events including acute myocardial infarction, unstable angina, and the implications for risk stratification of ejection fraction (EF) has not yet been defined in Japanese population.

Methods: We identified 1,895 patients who underwent stress dual-isotope SPECT and were followed up for the occurrence of acute myocardial infarction and unstable angina. The mean follow-up interval was 26.9 ± 15.5 months. One hundred forty-two patients were revascularized within 60 days after SPECT and they were censored from the prognostic analysis. Summed stress score (SSS), summed rest score (SRS), and summed difference score (SDS) were calculated using a 5-point scoring (Normal = 0, No uptake = 4) and a 20-segment model. Post-stress ejection fraction (EF) was derived automatically from quantitative gated SPECT (QGS) software.

Results: Nineteen myocardial infarction and 29 unstable angina occurred (1.1% and 1.6%, respectively). Univariate Cox proportional hazard regression analysis showed that hypertension (Wald 5.09, p < 0.05), post-stress EF (Wald 10.9, p < 0.01), SSS (Wald 12.4, p < 0.001), SDS (Wald 18.7, p < 0.001) were significant predictors of acute coronary syndrome (ACS: acute myocardial infarction and unstable angina). Multivariate Cox proportional hazard regression analysis showed that hypertension (Wald 4.27, p < 0.05) and SDS (Wald 8.59, p < 0.01) were independent predictors. When multiple clinical risk factors (number of coronary risk factors ≥ 2), ischemia (SDS ≥ 4), and impaired EF (EF < 45%) were applied into multivariate Cox proportional hazard regression analysis, combined assessment of ischemia and impaired EF showed highest predictive value (Wald 11.9; p < 0.001).

Conclusions: Post-stress EF by ECG-gated SPECT added incremental prognostic value to conventional myocardial perfusion SPECT.

35.24

ASSOCIATION OF LEFT ANTERIOR HEMIBLOCK WITH PERFUSION ABNORMALITIES AND CARDIAC EVENTS IN PATIENTS UNDERGOING STRESS TESTING FOR EVALUATION OF CORONARY ARTERY DISEASE

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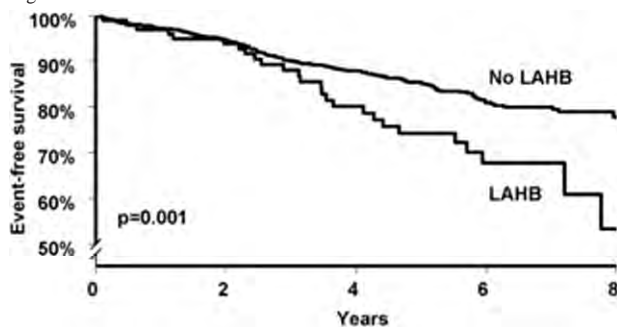
Background: The prognostic significance of isolated left anterior hemiblock (LAHB) in patients with no previous myocardial infarction is not clear. The aim of the study was to assess the relation between LAHB and incidence of perfusion abnormalities and adverse cardiac events in patients with suspected coronary artery disease (CAD) referred for stress myocardial perfusion imaging (MPI).

Methods: We studied 1,281 patients without history or electrocardiographic evidence of myocardial infarction. Patients underwent either symptom-limited exercise bicycle or dobutamine (up to 40 µg/kg/min) -atropine (up to 2 mg if needed) stress ^{99m}Tc-tetrofosmin single-photon emission computed tomography MPI. LAHB was defined from resting baseline 12-lead surface electrocardiogram as leftward QRS axis of -30° to -90° with rS patterns in lead II, III, aVF, and Q waves in aVL. Follow-up was successful in 1,276 (99.6%) patients. End points were cardiac death and non-fatal myocardial infarction.

Results: LAHB was present in 221 (17%) patients. Abnormal perfusion was detected in 125 (57%) patients with LAHB and in 466 (44%) patients without LAHB (p < 0.001). During the 5.4 ± 2 year of follow-up, the annual cardiac event rate (cardiac death, or nonfatal infarction) was significantly higher in patients with LAHB than in patients without (5.4% versus 3.2%, P = 0.001, see Figure 1).

Conclusions: In patients with suspected CAD and no previous myocardial infarction referred for stress MPI, LAHB is associated with an increased incidence of perfusion abnormalities and increased risk of hard cardiac events.

Figure 1.



35.25

A NOVEL APPROACH TO IDENTIFY PATIENTS AT HIGH CORONARY RISK IN THE PRESENCE OF ABNORMAL ACTIVATED LEFT VENTRICLES

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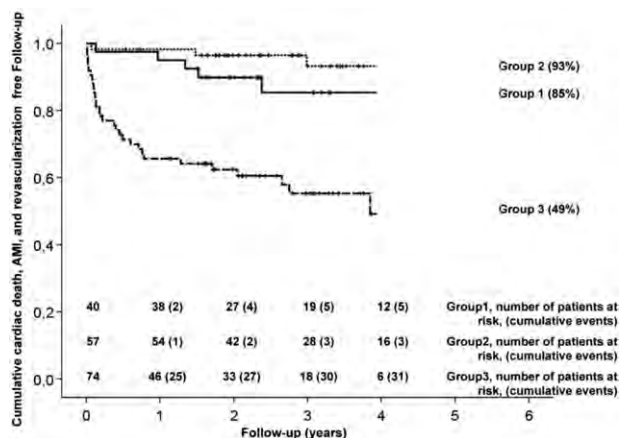
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Background: Myocardial perfusion single-photon emission computed tomography (MPS) has reduced value for evaluation of patients with left bundle branch block (LBBB) or right ventricular apical (RVA) pacing due to perfusion defects not associated with coronary artery disease (CAD). These defects are associated with abnormal wall motion in the same area as the perfusion defect is found. To increase the value of MPS for patients with chest pain and abnormal left ventricular activation we compared the prognosis of patients with normal MPS (Group 1), MPS with only abnormal activation related defects (AARD) (Group 2), and MPS with defects suggestive of CAD (Group 3).

Methods: Consecutive patients with chest pain and LBBB or RVA pacing referred for MPS were followed. AARD are small fixed or small reversible perfusion defects with concomitant wall motion abnormalities on gated MPS in well-defined regions with otherwise normal perfusion. MPS suggestive of CAD were all MPS that were not normal or showed perfusion defects other than only AARD. Cardiac events were acute myocardial infarction (AMI), coronary revascularization, and cardiac death.

Results: Between April 2002 and January 2006, 171 patients were studied. A normal MPS was observed in 40 patients, AARD in 57 patients, and an abnormal MPS in 74 patients. After a mean follow-up of 2.5 ± 1.5 years, 39 events were observed: 5 in Group 1, 3 in Group 2, and 31 in Group 3. The cumulative cardiac event-free follow-up was 85%, 93% and 49% for Groups 1, 2, and 3, respectively. The average annual cardiac event-rates were 4.3% per year, 1.7% per year, and 24% per year, respectively.

Conclusions: This large-scale study demonstrates that patients with chest pain and an abnormal left ventricular activation pattern can be categorized into patients at low and high future risk of cardiac events. A normal MPS or MPS with AARD warrants a watchful waiting whereas an abnormal MPS warrants prompt invasive imaging and possible coronary revascularization.



35.26

CLINICAL SIGNIFICANCE OF ISCHEMIC ELECTROCARDIOGRAPHIC CHANGES DURING STRESS MYOCARDIAL PERFUSION IMAGING: A SUB ANALYSIS OF J-ACCESS STUDY

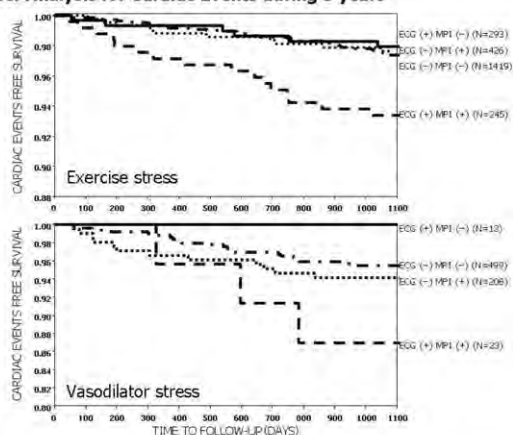
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Background: Ischemic ST-segment depression (STD) on electrocardiogram during stress myocardial perfusion imaging (MPI) is reported to assess coronary artery disease severity.

Methods and Results: Among 4,670 registered patients for J-ACCESS study, patients with conduction abnormality on baseline were excluded. A total of 3,125 patients performed exercise (N=2,383) or vasodilator (N=742) stress MPI and significant STD were obtained in 538 patients during exercise and 35 patients during vasodilator stress. Kaplan-Meier analysis revealed that the patients with both STD and reversible perfusion defect on MPI had significantly higher incidence for cardiac events in both exercise and vasodilator stress. Interestingly, patients without reversible perfusion defect showed significantly fewer events despite presence of STD. **Conclusions:** STD during both exercise and vasodilator stress is well associated with higher incidence of cardiac events in patients demonstrating reversible perfusion defect on MPI.

Kaplan-Meier Analysis for Cardiac Events during 3 years



ECG = ischemic ST segment depression during stress, MPI = reversible perfusion defect on MPI

35.27

EVALUATION OF SPECT MPI FINDINGS IN PATIENTS REFERRED FOR SYNCOPE

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Background: Recent guidelines for the evaluation of syncope suggest that an ischemic work-up is "appropriate in patients at risk for or with a history of coronary artery disease," yet syncope is not addressed in the American College of Cardiology Foundation/American Society of Nuclear Cardiology Appropriateness Criteria (AC) for single-photon emission computed tomography myocardial perfusion imaging (SPECT MPI). Recently ASNC has suggested syncope be addressed in revisions to the AC, though the findings on SPECT MPI in patients referred for syncope have not been studied. Our aim was to describe the prevalence of abnormal findings on SPECT MPI in patients for whom syncope was the primary indication.

Methods: We retrospectively identified consecutive patients referred to our laboratory for clinically indicated SPECT MPI for which syncope was the primary indication. Cardiovascular risk factors, prior documented coronary artery disease (CAD), and estimated Framingham risk were recorded. Patients with syncope were compared to a control database of consecutive patients for whom pre-test probability of CAD was recorded. SPECT MPI findings including summed stress scores (SSS) ≥ 4 , SSS > 8 , LVEF $< 35\%$, and composite high-risk findings (SSS > 8 or LVEF $< 35\%$) were recorded.

Results: Among 8,550 consecutive patients referred for clinically indicated SPECT MPI, syncope was the primary indication in 144

(1.7%). Overall, abnormal SPECT MPI findings were common in patients with syncope, including SSS ≥ 4 (30%), SSS > 8 (12%), LVEF $< 35\%$ (4%), and composite high-risk findings (14%). Of patients referred for syncope, 42% were found to be at high pre-test risk for CAD (defined as a prior known CAD, a coronary risk equivalent, or Framingham risk $> 20\%$), while 58% were not. Syncope patients at high pre-test CAD risk were found to have the highest prevalence of abnormal SPECT findings, including SSS ≥ 4 (38%), SSS > 8 (15%), LVEF $< 35\%$ (10%), and composite high risk-findings (18%). However, abnormal SPECT MPI findings remained common among syncope patients without high pre-test CAD risk, including SSS ≥ 4 (24%), SSS > 8 (10%), LVEF $< 35\%$ (2%), and composite high-risk findings (11%). Syncope patients without high pre-test CAD risk were found to have similar findings to control patients who had been referred for an indication of chest pain and with an intermediate pre-test probability of CAD, a group deemed to be appropriate for SPECT MPI by the AC, with SSS ≥ 4 (26%*), SSS > 8 (10%*), LVEF $< 35\%$ (3%*). *Each p=NS compared to syncope without high CAD risk group.

Conclusions: While syncope as the primary indication for SPECT MPI represents a small fraction of clinically ordered studies, syncope patients referred for SPECT MPI are found to have a high prevalence of abnormal and high-risk SPECT MPI findings. These abnormalities are not limited to those syncope patients at high pre-test CAD risk and are similar to those found in other symptomatic intermediate risk groups. These findings suggest current clinical referral practice is appropriate.

35.28

INCIDENCE OF ABNORMAL STRESS MPI IN OBESE PATIENTS WHO ARE CANDIDATES FOR BARIATRIC SURGERY

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Background: Stress testing is commonly performed pre-operatively in patients who are candidates for bariatric (gastric bypass) surgery. The prevalence of ischemia, infarction, or left ventricular dysfunction has not been defined in this population. The purpose of this study was to assess the incidence of abnormal stress myocardial perfusion imaging (MPI) in obese patients who are candidates for bariatric surgery.

Methods: Using single-photon emission computed tomography MPI, 478 consecutive patients (84% women) were studied over a 4-year period (2004-2007). Mean body mass index was $49 \pm 8 \text{ kg/m}^2$. Exercise stress was performed in 82% and adenosine stress was performed in 18% of patients. All patients were imaged with Tc-99m sestamibi, using a gated SPECT with gadolinium-based attenuation correction. Quantification of MPI was performed using an automated program (Autoquant), to derived summed stress scores (SSS) based on a 20-segment model. Abnormal studies were defined as having significant reversible or fixed perfusion defects, or left ventricular dysfunction.

Results: Four hundred thirty-eight (91.6%) patients had normal stress MPI. Seventeen (3.6%) patients had equivocal studies, mostly due to uncorrectable attenuation or motion artifacts. Twenty-three (4.8%) patients had abnormal MPI. Mean SSS in normal, equivocal, and abnormal studies was 6.2 ± 8.8 , 3.9 ± 2.7 , 0.1 ± 0.3 , respectively ($p < 0.05$). Only 4 (0.08%) patients had moderate to severe perfusion defects (SSS ≥ 9). In the subgroup of patients with exercise stress, Duke treadmill score was similar in patients with abnormal and normal MPI (5.5 ± 2.2 vs 6.3 ± 1.6 , $p = 0.07$).

Conclusion: There is a low incidence of moderate to severely abnormal MPI studies in obese patients who are candidates for bariatric surgery. Additional studies are warranted to determine which patients will benefit from preoperative testing.

35.29

THE RELATIONSHIP BETWEEN GLYCOSYLATED HEMOGLOBIN AND MYOCARDIAL PERFUSION IMAGING

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Background: Among modifiable risk factors for coronary artery disease (CAD) is diabetes mellitus (DM), for which long term control is measured using glycosylated hemoglobin (Hgb A1C). Functional studies, including myocardial perfusion imaging (MPI) and coronary angiography are vital to the diagnosis and risk stratification of CAD. To this point, studies focusing

on the detection of CAD in diabetics have not examined long-term glucose control (measured by Hgb A1C) relative to MPI abnormalities suggesting CAD. We hypothesized that diabetics with poorly controlled Hgb A1C would have more abnormal MPI compared to both non-diabetics and diabetics with tighter glycemic control.

Methods: This was a retrospective evaluation of 506 consecutive patients over 3 months referred to a single center for stress testing with myocardial perfusion imaging. All patients completed either a symptom limited exercise test using a standard Bruce protocol or received a weight-based Persantine infusion over 4 minutes followed by 4 minutes of low level treadmill exercise if able to exercise. A one-day imaging protocol was performed using approximately 10 millicuries of Technetium 99m-Sestamibi for rest imaging and approximately 30 millicuries of Technetium 99m-Sestamibi injected at peak stress for stress imaging. Gated acquisition was performed on the stress images. The electronic medical record was used for access to the demographics and relevant medical history including coronary artery disease and risk factor profile.

Results: Diabetics in this study (n=152) had a higher risk of abnormal MPI (including ischemia, infarction, and mixed ischemia/infarction) compared to non-diabetics (relative risk [RR] = 1.58). Twenty-eight diabetics were considered to have poor glycemic control (Hgb A1C of 8% or higher). This population with poor glycemic control had significantly higher risk of abnormal MPI (RR = 1.84) compared to non-diabetics. This increased risk of abnormal MPI for diabetics with poor glycemic control was also present when compared to diabetics with HgbA1C < 8 (RR = 1.20). The presence of obstructive CAD (defined at coronary angiography as a 70% or greater stenosis in one or more coronary arteries) supports the MPI results; 53.5% of the patients in the poorly controlled diabetic subgroup had CAD, significantly higher than 25.7% of non-diabetic patients found to have CAD. **Conclusion:** The importance of strict glycemic control in patients with DM with respect to reducing vascular complications is well known. Our study shows a higher risk of abnormal MPI and CAD in diabetics with poor long-term glycemic control compared to both non-diabetics and diabetics with tighter glycemic control, further emphasizing the need for aggressive risk factor modification as a means of minimizing the impact of vascular complications from DM.

35.30

DIAGNOSTIC AND PROGNOSTIC SIGNIFICANCE OF ISCHEMIC ELECTROCARDIOGRAPHIC CHANGES DURING VASODILATOR STRESS MYOCARDIAL PERFUSION SPECT

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Background: Conventional exercise electrocardiographic (ECG) criteria applied in previous studies have demonstrated an association between ECG changes and coronary artery disease (CAD), including outcomes, during vasodilator stress myocardial perfusion single-photon emission computed tomography (MPS). However, the diagnostic and prognostic significance of a lower threshold for ST-segment depression during vasodilator stress is unknown.

Methods: We identified 657 patients with dipyridamole SPECT and cardiac catheterization within 90 days (March 1996 to December 2005). Horizontal or down-sloping ST-segment depressions were measured 80ms after the J-point and recorded in 0.5mm increments. Significant CAD by cardiac catheterization was defined as > 70% stenosis of any vessel or ≥ 50% stenosis of the left main. Summed stress score (SSS) was used to assess perfusion and classified as: normal (SSS ≤ 3), mildly abnormal (SSS 4-8) and moderately to severely abnormal (SSS > 8). Mean follow-up after testing was (94%) complete over 3.5 years ± 5 years. Outcome events noted were revascularization, cardiac death, or nonfatal myocardial infarction.

Results: Of the 657 patients, 314 (47.8%) developed ST-segment depression ≥ 0.5mm. In patients with a SSS 4-8 or SSS > 8, ST-segment depression ≥ 0.5mm was associated with a higher incidence of CAD (p = 0.003, p = 0.0001, respectively) (Panel A). A total of 142 events occurred in patients with ST-segment depression ≥ 0.5mm. The presence of ST-segment depression ≥ 0.5mm did not affect the outcomes in patients with a SSS ≤ 3 (p = 0.473). However, in patients with a SSS 4-8, ST-segment depression ≥ 0.5mm was associated with higher incidence of cardiac events compared to those with <0.5mm ST-segment depression (p = 0.035) (Panel B).

Conclusion: A threshold of 0.5mm for ST-segment depression during vasodilator stress has both diagnostic and prognostic significance and thus, may be of value in guiding therapeutic decisions in post-test management.

35.31

ROLE OF RUBIDIUM-82 POSITRON EMISSION TOMOGRAPHY MYOCARDIAL PERFUSION IMAGING IN PATIENTS WITH DIABETES — IS IT GOOD, BETTER, OR WORSE?

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Background: Diagnostic accuracy of gated Rubidium-82 positron emission tomography (PET) perfusion imaging to identify multi-vessel disease in diabetic patients is not well defined.

Methods: We studied 118 patients with known or suspected coronary artery disease (CAD) who underwent dipyridamole stress gated 82 Rb PET, with subsequent cardiac catheterization, excluding those with history of coronary artery bypass graft or left bundle branch block. A blinded, visual scoring of perfusion images was accomplished using a 17-segment model. Patients were stratified based on summed difference score (SDS) [normal ≤ 2 vs. abnormal > 2], reversible regional wall motion score (RRWMS) [normal ≤ 2 vs. abnormal > 2], and transient cavity dilatation (TID). CAD was defined by ≥ 50% stenosis of left main or ≥ 70% stenosis of any major coronary vessel. We calculated the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of the above mentioned variables for diagnoses of multi-vessel CAD in both diabetic (DM) and non-diabetic (NDM) patients.

Results: Of 118 patients, 59 were diabetic (50%). There was no difference in age (65 + 10 vs. 67 + 10) or gender (46% vs. 55%) between DM and non-DM. Diabetics had had higher prevalence of multi-vessel disease (MVD) (60% vs. 48%). The presence of SDS, RRWMS, and TID were significantly associated with MVD for non-DM and DM patients. The sensitivity, specificity, and positive and negative predictive values of different scintigraphic markers are presented in Table 1. The diagnostic accuracy for detection of MVD remained comparable between DM and NDM.

Conclusions: Multi-vessel coronary artery disease can be identified effectively by using various scintigraphic variables in diabetic patients undergoing gated Rubidium-82 PET myocardial perfusion imaging.

Table 1.

		Sensitivity	Specificity	PPV	NPV	Accuracy
RRWMS	NDM	70%	80%	76%	75%	75%
	DM	60%	78%	80%	56%	67%
	P value	NS				
SDS	NDM	86%	54%	63%	80%	69%
	DM	83%	40%	60%	66%	65%
	P value	NS				
TID	NDM	36%	80%	87%	72%	62%
	DM	41%	79%	74%	48%	62%
	P value	NS				
Combination of all variables	NDM	86%	54%	64%	80%	69%
	DM	83%	45%	62%	66%	68%
	P value	NS				

35.32

RUBIDIUM-82 POSITRON EMISSION TOMOGRAPHY MYOCARDIAL PERFUSION IMAGING FOR DIAGNOSES OF CORONARY ARTERY DISEASE IN WOMEN

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Background: Single-photon emission computed tomography (SPECT) myocardial perfusion imaging is often suboptimal for detection of coronary artery disease (CAD) in women. The diagnostic accuracy of gated Rubidium-82 PET perfusion imaging is not well established for women.

Methods: We studied 56 women with known or suspected CAD who underwent dipyridamole stress gated 82 Rb PET, with subsequent cardiac catheterization, excluding those with history of coronary artery bypass graft or left bundle branch block. A blinded, visual scoring of perfusion images was accomplished using a 17-segment model. Patients were stratified based

on summed difference score (SDS) [normal 2], reversible regional wall motion score (RRWMS) [normal 2], and transient cavity dilatation (TID). CAD was defined by > 50% stenosis of left main or > 70% stenosis of any major coronary vessel. We calculated the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of the above mentioned variables for diagnoses of CAD. We generated receiver operator characteristics curves and areas under curves to estimate the accuracy of various variables. Multivariate analysis was performed by logistic regression analysis.

Results: The mean age was 64 + 8. Thirty-four percent of patients were older than 70 years, 57% were diabetic, 29% had history of previous myocardial infarction, and 64% were obese. The presence of SDS, RRWMS, and TID were independent predictors for diagnoses of CAD. The sensitivity, specificity, and positive and negative predictive values of different scintigraphic markers are presented in Table 1.

Conclusions: CAD can be identified effectively by using various scintigraphic variables in women undergoing gated Rubidium-82 PET myocardial perfusion imaging.

Table 1.

Diagnostic Accuracy of PET-MPI for CAD Women

Variable	Sensitivity	Specificity	PPV	NPV	Accuracy
Summed Difference Score	92%	60%	81%	80%	81%
Transient Cavity Dilatation	49%	95%	95%	52%	65%
Reversible Wall motion Abnormality	59%	85%	88%	54%	68%
Combination of all variables	92%	64%	83%	80%	83%

35.33

ADENOSINE-INDUCED HIGH-GRADE HEART BLOCK DURING STRESS TEST — INCIDENCE AND RISK PROFILE IN 1,376 PATIENTS

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Background: Adenosine stress test with myocardial perfusion imaging (MPI) is one of the most important methods assessing myocardial ischemia, with annual volume exceeding one million patients. It is common knowledge that adenosine can cause bradycardia in some patients. But little is reported regarding specific patient type, who may be at increased risks for the procedure. We sought to identify some risk makers in patients who had adenosine-induced high-grade heart block.

Methods: We analyzed the results of 1,376 consecutive patients who had adenosine stress test over a 15-month period. The patients had the appropriate indications for adenosine stress test with MPI according to the American Society of Nuclear Cardiology (ASNC) guidelines. We assessed baseline patient characteristics including age, gender, prior cardiac procedures (angioplasty, stent, coronary artery bypass surgery, or valve surgery), baseline heart rate, first degree atrial-ventricular block (AVB), or left bundle branch block (LBBB). Patients who had high-grade heart block were defined as having second or third degree AVB. Pearson Chi Square and student T test were used to compare the risk profiles of the Heart Block group and control group.

Results: There were total of 1,376 patients with an age span of 25 to 91 years. The incidence of heart block was 4.3% (59 of 1376 patients). There were no significant differences in systolic and diastolic blood pressures between the 2 groups. All patients with heart block recovered spontaneously or with aminophylline administration.

Group	Age (years)	Male n = 638	Female n = 738	Cardiac procedures	Heart rate (beats/minute)	LBBB	1 st degree AVB
Control	68.59 ± 12.19	616/1317 (44.76%)	701/1317 (55.23%)	275/1317 (20.88%)	69.08 +/-12.76	55/1317 (4.20%)	45/1317 (3.42%)
Heart Block	71.05 ± 11.35	22/59 (37.28%)	37/59 (62.72%)	18/59 (30.50%)	70.55 +/-12.25	9/59 (1.60%)	30/59 (50.84%)
P value	0.05	0.13	0.07	0.02	0.36	0.19	< 0.001

Conclusion: Adenosine administration during stress tests is generally safe even in very elderly patients if given in compliance with ASNC guidelines, although patients with more advanced age may have higher risks of AVB. Our study confirmed relatively low incidence of 4.3% high grade AVB but no fatal or prolonged bradycardia requiring temporary pacemaker. Patients with previous cardiac procedures, and most strikingly, baseline first degree AVB seemed to have an elevated risk of high-grade AVB with adenosine infusion.

35.34

DIAGNOSTIC BENEFIT OF COMBINED CORONARY CALCIUM AND PERFUSION ASSESSMENT IN PATIENTS UNDERGOING PET/CT MYOCARDIAL PERFUSION STRESS IMAGING

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Introduction: An important diagnostic limitation of stress perfusion imaging is its inability to detect non-obstructive coronary artery disease (CAD), thereby potentially misclassifying patients as normal who in fact have substantive plaque burden. Positron emission tomography/computed tomography (PET/CT) perfusion imaging is being increasingly used in patients who cannot complete exercise stress imaging, a higher risk cohort for major cardiac events. One potential advantage of PET/CT is same-setting measurement of coronary artery calcium score (CACS), an index of plaque burden. The purpose of this study was to evaluate the prevalence and severity of subclinical CAD through detection of coronary calcium on the CT image data in patients without a CAD history and normal cardiac stress PET/CT imaging.

Methods: Between March 2007 and August 2007, we performed a same-setting Agatston CACS in all patients with no prior diagnosis of CAD who were referred for clinically indicated adenosine or dipyridamole stress rubidium-82 PET/CT myocardial perfusion imaging. We identified for analysis of prevalence and severity of CACS all 220 patients who had normal PET stress perfusion images. The correlation between the presence and extent of coronary calcification and traditional cardiovascular risk factors was evaluated. All PET/CT studies were performed utilizing a Siemens Biograph-16 PET/CT scanner.

Results: Of the 220 patients with a normal PET scan, 148 (67%) were women; mean patient age was 64 ± 13 years. The test indication was chest pain in 68%. Traditional risk factors included diabetes in 25%, hypertension in 72%, hyperlipidemia in 70%, and 17% were current smokers. The mean pre-test probability of obstructive CAD based on the Diamond-Forrester classification of age, gender, and symptoms was 34% ± 23%. Of the 220 patients, 137 (62%) were diagnosed with subclinical CAD based on an abnormal CACS. Importantly, 28% of the entire cohort had a CACS ≥ 100, 7% had CACS > 400, and 5% had CACS > 1000.

Conclusion: Subclinical CAD was detected in the majority of our patients with normal myocardial perfusion assessed by hybrid PET/CT imaging and no prior diagnosis of CAD. The integration of formal calcium scoring into the diagnostic evaluation utilizing PET/CT stress imaging results in an enhanced ability to diagnose coronary artery disease in those without perfusion evidence of obstructive CAD. Identification of subclinical CAD in this patient population may permit better cardiac risk stratification and modification of cardiovascular risk factors.

35.35

THE UTILITY OF REPEAT STRESS SPECT MYOCARDIAL PERFUSION IMAGING IN PATIENTS WITH END STAGE LIVER DISEASE

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Background: Liver transplantation is a life-saving procedure. With a national mean waiting time of 14 months, some candidates may undergo as part of their medical clearance repeat pre-operative stress testing. The utility of repeating stress single-photon emission computed tomography myocardial perfusion imaging (SPECT MPI) in patients with an initial normal study is unknown. The purpose of this study was to investigate the utility of repeat MPI in end stage liver disease patients awaiting transplantation after a previously normal study.

Methods: We analyzed all patients that had a pre-liver transplantation pharmacologic stress (dipyrimadole or adenosine) SPECT Tc-99m sestamibi MPI study in a 36-month period (January 2005 to January 2008) at Mount Sinai Medical Center. Patients with an initial abnormal study were excluded. Subjects were categorized as having had a repeat stress test ("repeats") or no repeat stress test ("non-repeats"). Using the Social Security Death Index, the non-repeat patients were categorized as being either alive or expired. A pre-test cardiac risk score using age, gender, presence of chest pain, diabetes and history of a myocardial infarction was calculated and all patients were categorized as low, intermediate, or high pre-test risk for the presence of coronary artery disease (CAD).

Results: A total of 810 liver transplant candidates who underwent SPECT MPI studies were identified. Of those, 618 (76%) studies were interpreted as normal. Forty-five (8%) subjects had a repeat stress test 17.8 ± 9.9 months after the initial normal stress test. All repeat stress tests were normal. Of the non-repeat group, 130 (23%) patients expired within 7.7 ± 8.7 months and 443 (77%) patients were alive after a mean follow-up of 24.3 ± 14.6 months after the initial test. Comparing demographic and cardiac risk parameters between the repeat and non-repeat groups, there were no statistically significant differences found. Comparing the repeat group to the expired group, 89% vs. 75% (p=0.089) were low pre-test probability for CAD, 11% vs. 15% (p=0.73) were intermediate and 0% vs. 10% (p=0.04) were high pre-test risk for CAD.

Conclusion: The majority of SPECT stress tests done in patients with end stage liver disease awaiting liver transplantation are normal and the majority of the patients have a low pre-test risk for the presence of CAD. None of the normal stress tests repeated after 17.8 ± 9.9 months became abnormal. Thus, in this low risk cohort of patients who have an initial normal SPECT MPI, repeat testing during the waiting period appears unnecessary.

35.36

CARDIAC EVENTS AFTER 1 AND 5 YEARS OF A NORMAL MYOCARDIAL PERFUSION SCINTIGRAPHY IN ELDERLY

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Background: Life expectancy is increasing and cardiovascular disease is the principal cause of death in the elderly. Myocardial perfusion scintigraphy (MPS) is an excellent non-invasive risk stratification method. The time to repeat a MPS in the elderly is not completely defined. The aim of this study was to evaluate cardiac events (CE) after 1 and 5 years of a normal MPS in elderly patients with multiple cardiac risk factors.

Methods: This retrospective study included 74 elderly patients (p) who underwent MPS in 2006. All patients were > 70 years (mean = 76.82 years) and normal MPS. From the total, 59.5% were female, 90.5% had hypertension, 27% had diabetes, 64.9% had high cholesterol levels, 18.9% were smokers, 20.3% had a previous coronary artery bypass graft, and 25.7% had previous percutaneous transluminal coronary angioplasty. The MPS with MIBI-Tc-99m were performed by gated single-photon emission computed tomography technique and a standard 2-day protocol. The stress performed was maximal exercise (max ETT) in 16.22%, submaximal exercise (SubETT) in 41.89%, and dipyridamole (dip) in 41.89%. It was considered CE cardiac death, myocardial infarction, and revascularization procedures during the follow-up period. To verify the association between sub ETT, max ETT, and dip stress test with CE in 1 and 5 years it was used the Fisher exact test being considered significant if p value < 0.05.

Results: Although all perfusion images were normal, 31.8% exercise tests and 9.5% dip were suggestive of ischemia. After 1 year the total CE presented was 1.35%, and after 5 years, 9.46%. Elderly who performed Max ETT MPS do not presented CV after 5 years while those who performed subETT MPS presented 12.9% (6.45% in the suggestive of ischemia group, p = NS) of CE. Patients who were submitted to dip MPS presented 9.61% of CE after 5 years (6.45% in the suggestive of ischemia group, with p < 0.05).

Conclusions: In the studied group, elderly presented low risk of CE after 1 year of a normal MPS. Elderly who performed maximal exercise had not presented CE in 5 years while those who performed subETT MPS or dip MPS had presented more CE after 5 years and should repeat a MPS, mostly if they have a suggestive of ischemia dipyridamole stress.

35.37

CARDIAC X SYNDROME: ENDOTHELIAL DYSFUNCTION AND ENDOTHELIN AND RECEPTOR POLYMORPHISM

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Background: Cardiac X Syndrome (CXS) is related to ischemic microcirculatory mainly due to endothelial dysfunction (ED). The objective of this study was to evaluate: a) myocardial ischemia, b) ED, c) prevalence of receptor endothelial Lys198Asn and endothelin polymorphism G231.

Methods: All 32 CXS: coronary-angiography, stress single-photon emission computed tomography (SPECT), Dependent Flow-Mediated Vasodilation (DFMV), and Endothelin-Independent Nitroglycerine Mediated Vasodilation (EINMV) by Doppler ultrasound. Endothelin receptor G231 and Endothelin Lys198Asn polymorphisms were determined by polymerase chain reaction technique in the CXS and in 36 healthy unrelated individuals. Significance of the differences between groups: chi-square analysis.

Results: ED in all 32 patients (100%); severe in 23 with significant SPECT ischemia; moderate in 9 (Table 1). Endothelin Lys198Lys genotype significantly decreased in CXS when compared to healthy controls and also when compared between severe and moderate ED degree (Tables 2-3).

Table 1. Demographic, ED, and SPECT myocardial ischemia

Variable	Endothelial dysfunction: severe n (%) (DFMV less than 5%)		Endothelial dysfunction moderate n (%) (DFMV between 5 to 10%)	
	n=32 (total%)	n=23 (relative%)	n=32 (total%)	n=9 (relative%)
Gender				
Male	12 (37.5)		3 (9.4)	
Female	11 (34.4)		6 (18.8)	
Menopause	9 (28.1)		4 (12.5)	
Diabetes Mellitus	3 (9.3)		0 (0)	
Hyperuricemia	1 (3.1)		2 (6.2)	
Arterial Hypertension	11 (34.3)		5 (15.6)	
Smoking	1 (3.1)		2 (6.2)	
Dyslipidemia	13 (40)		5 (15.6)	
LDL < 100 mg/dl	10 (31.2)		4 (12.5)	
Age (mean ± SD)	56.7±9.85		51.8±12	
HDL > 40 mg/dl	8 (25)		2 (6.2)	
SPECT TID (Subendocardial ischemia)	6 (18.8)	6 (26)	1 (3.1)	1 (11)
Regional Ischemia	17 (53.1)	17 (74)	6 (18.8)	6 (66)
Ischemia (SPECT TID and Regional Ischemia)	19 (59.4)	19 (82)	6 (18.5)	6 (66)
Without ischemia	4 (12.5)	4 (17)	3 (9.4)	3 (33)

Table 2. Polymorphism and CXS

Variable *1 data *3 data lost/missed	Controls n=36 (100%)	CXS n=32 (100%)	Odds ratio (OR)	CI (95%)	p
Lys198 GG ^a	29 (80.6)	17 (54.8)	0.293	0.099-0.869	0.035
Lys198 GT ^a	5 (13.9)	10 (32.3)	2.95	0.882-9.881	0.86
Lys198 TT ^a	2 (5.6)	4 (12.9)	2.519	0.429-14.80	0.404
G231 AA ^b	6 (16.7)	3 (11.5)	0.652	0.147-2.890	0.722
G231 GA ^b	10 (27.8)	6 (23.1)	0.780	0.243-2.508	0.773
G231 GG ^b	20 (55.6)	17 (65.4)	1.51	0.533-4.28	0.600

Table 3. Endothelial dysfunction and polymorphism

Variable ^a 1 data ^b 3 data lost/missed	Endothelial dysfunction severe n (%) (DFMV less than 5%)	Endothelial dysfunction moderate n (%) (DFMV between 5 to 10%)	Odds ratio (OR)	CI (95%)	p
Lys198 GG ^a	10 (43.5)	7 (87.5)	0.110	0.012-1.04	0.045
Lys198 GT ^a	9 (39.1)	1 (12.5)	4.5	0.47-42.47	0.222
Lys198 TT ^a	4 (17.4)	0 (0)	1.2	1.0-1.46	0.550
G231 AA ^b	3 (15)	0 (0)	1.17	0.979-1.4	1.0
G231 GA ^b	3 (15)	3 (50)	0.176	0.023-1.32	0.112
G231 GG ^b	14 (70)	3 (50)	2.23	0.36-15.05	0.628

Conclusions: All 32 CXS had endothelial dysfunction. Higher prevalence of myocardial ischemia was present in severe endothelial dysfunction group. Different distribution of the Lys198Asn polymorphism suggests a genetic base.

35.38

GLOMERULAR FILTRATION RATE AND LIKELIHOOD OF ABNORMAL STRESS MYOCARDIAL PERFUSION SCANS

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Introduction: Chronic kidney disease has been suggested but not established as a coronary artery disease equivalent. Consequently, we hypothesized that the incidence of abnormal stress myocardial perfusion scans is higher in patients with chronic kidney disease determined by impaired glomerular filtration rates (GFRs).

Methods: We conducted a retrospective analysis of patients without known coronary artery disease (CAD) who were referred to our nuclear laboratory for a clinically indicated stress myocardial perfusion scan between January 2005 and December 2007. Subjects selected for this analysis had measurement of their GFRs within one month of the stress myocardial perfusion scan. GFR was calculated according to the Modification Diet in Renal Disease (MDRD) study formula: $32788 \times \text{serum creatinine } (\mu\text{ mol/L})^{-1.154} \times \text{age}^{-0.023} \times (0.742 \text{ if female}) \times 1.21 \text{ (if African-American)}$. Patients were classified into 3 groups based on GFR: A (normal > 60), B (mild to moderately reduced 30-60), and C (severely reduced < 30) in ml/min/1.73m². Gated stress myocardial perfusion SPECT scans were performed using a dual isotope protocol. An experienced reader who was blinded to the results of the GFRs read the perfusion scans. Scans with a summed stress score of greater than 2 were considered abnormal.

Results: Two hundred forty subjects (mean age 65 years \pm 14 yrs; 58% female) were included in the analysis with the following distribution: A = 160, B = 55, C = 25. The incidence of abnormal scans in group A was 17%, in group B 38% and in group C 44%. By chi square analysis, Group A against B had an odds ratio of 2.2 (95% CI 1.16 - 4.17) p=0.01, Group A against C an odds ratio of 2.33 (95% CI 0.97 - 5.61) p = 0.05 and Group B against C an odds ratio of 1.06 (95% CI 0.42 - 2.26) p=0.9. Furthermore, Group A against the combination of groups B and C had an odds ratio 2.24 (95% CI 1.25 - 4) with p=0.006. In a multivariate analysis including age, gender, history of hypertension, diabetes mellitus, hyperlipidemia, smoking, and family history of CAD, the odds ratio of abnormal perfusion scans in patients with GFR <30 was 2.43 (p=0.07).

Conclusion: We conclude that the incidence of abnormal scans is higher in patients with impaired GFR. After controlling for other risk factors for CAD, severe impairment of GFR tended to independently predict an abnormal stress myocardial perfusion study.