# D-SPECT: A Novel Technology for High Speed Gated Myocardial Perfusion Imaging: A Comparison Between High Speed (D-SPECT) and Dual Detector Anger Camera (A-SPECT)

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**Objective**: Gated myocardial perfusion imaging by Anger SPECT camera (A-SPECT) has the limitation of prolonged imaging time. A novel, compact camera (D-SPECT, Spectrum-Dynamics, Haifa, Israel), was designed to increase sensitivity as well as spatial and energy resolution by employing a bank of independently controlled detector columns with large hole tungsten collimators in front of multiple cadmium zinc telluride (CZT) crystal arrays. The study compares high speed D-SPECT to conventional A-SPECT imaging for the evaluation of gated myocardial perfusion in patients with known or suspected coronary artery disease.
**Methods**: Thirty patients (27 men, 16 with known CAD) underwent one day Tc99m Sestamibi stress/rest SPECT. D-SPECT images were performed within 30 min after A-SPECT. Stress/rest acquisition times were 19 and 11 min respectively for A-SPECT, and 4 and 2 min respectively for D-SPECT. Images were visually analyzed using a 20-seg model to calculate summed stress (SSS) and rest (SRS) scores. Images were also scored for quality, using a 1-5 scale (1=poor, 5=excellent), and assessed for confidence of interpretation. Post stress left ventricular ejection fraction and left ventricular volumes were computed and compared in 11 patients for both A-SPECT and D-SPECT. Myocardial counts per min (cpm) were calculated for both A-SPECT and D-SPECT. **Results**: Myocardial count rate was significantly higher in D-SPECT compared with A-SPECT (384k/min ± 134k/min vs 47k/min ± 14k/min, respectively, $p<0.0001$) for stress, and (962k/min ± 426k/min vs 136k/min ± 37k/min, respectively, $p<0.001$) for rest.
Overall image quality was rated good and higher in 29 (97%) cases for D-SPECT, and 18 (93%) cases for A-SPECT (p=NS). D-SPECT SSS and SRS correlated linearly with A-SPECT respective scores ($r=0.84$, $p<0.0001$ for SSS, and $r=0.92$, $p<0.001$ for SRS). Of the 30 studies, 23 (77%) were diagnosed as definite normal or abnormal by D-SPECT, and 22 (73%) by A-SPECT (p=NS). Analysis of gated SPECT variables in 11 patients yielded that D-SPECT post-stress EF, EDV and ESV were highly correlated with the respective A-SPECT measurements (R 0.87, 0.97, 0.99, respectively, $p<0.001$), with insignificant difference from identity. **Conclusions**: D-SPECT is a novel technology, providing fast gated myocardial perfusion imaging with high image quality and improved resolution, with up to 8 times increased sensitivity. The amount of perfusion abnormality visualized by D-SPECT and computed gated SPECT variable is highly correlated to A-SPECT, with an equivalent level of diagnostic confidence. **Clinical Relevance:** The benefits related to the increased sensitivity include improved patient comfort due to rapid examinations and lowering radiopharmaceutical dose. The superior image quality should translate to more accurate and fewer ambiguous interpretations than are observed with A-SPECT.

# Framingham and UKPDS Risk Scores Predict Extent and Severity of Coronary Disease as Determined by 64 Slice Coronary CT Angiography in Asymptomatic Patients with Type 2 Diabetes Mellitus

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**Background and aims:** Framingham and UKPDS risk scores are clinically useful for long-term primary prediction of coronary heart disease (CHD) events. The relationship of these scores to extent of sub-clinical coronary atheroma is not known. We examined the correlation of 10 year CHD risk with extent of prevalent sub-clinical coronary atheroma using 64 slice coronary CT angiography (CTA) in asymptomatic pts with type 2 diabetes mellitus (DM) enrolled in an ongoing prospective outcomes study.

**Methods:** Contrast enhanced 64-slice CTA was performed in 423 consecutive diabetic pts with no known coronary disease (age 63.4±5.3 yrs, 58% women, mean duration of DM 10.3±7.8 yrs, 35% receiving insulin). Framingham and UKPDS 10 year risk scores were calculated from baseline pt characteristics.

**Results:** Less pts were defined as low risk by Framingham (11.7%) than UKPDS (20.2%), nearly 40% were at high risk by both scores and remainder intermediate risk. Multivessel coronary plaque was present in 233 (55%) pts. Prevalence of coronary plaque increased with both level of Framingham and UKPDS risk (Table). Plaque prevalence correlated similarly with level of risk for both men and women. Amongst variables not included in risk scores (insulin treatment, ankle brachial ratio, serum CRP and serum fibrinogen) the ankle-brachial ratio predicted presence of multivessel coronary plaque independently of risk scores (Framingham p=0.018; UKPDS p=0.036).

**Conclusions:** In asymptomatic subjects with DM and no history of CAD undergoing 64 slice CTA 1. Multivessel plaque was common at all levels of risk. 2. Prevalence and extent of plaque increased with both Framingham and UKPDS risk. 3. The ankle-brachial ratio added independent information to that from either risk score..

Coronary plaque in relation to level of risk

| Risk | Any plaque N (%) pts | | Multivessel plaque N (%) pts | | Stenosis (>50%) N (%) pts | |
|---|---|---|---|---|---|---|
| | Fram | UKPDS | Fram | UKPDS | Fram | UKPDS |
| Low (<10% 10yr risk) | 26 (54.0) | 22 (55.0) | 15 (31.0) | 21 (28.0) | 4 (8.1) | 7(9.0) |
| Intermediate (10%-20% 10yr risk) | 148 (77.0) | 126 (75.0) | 105(54) | 85 (50.0) | 45 (24) | 28 (17.3) |
| High (>20% 10yr risk) | 131 (85.0) | 134 (91.0) | 96 (61.9) | 111 (75.3) | 39 (25.0) | 56 (38.0) |
| p-value | <0.001 | <0.001 | 0.001 | <0.001 | 0.04 | <0.001 |

# Is there a Clinical Advantage of Doing Complementary Study of Stress SPECT or Stress Echo over One Image Modality ?

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One of the problems of the assessment of IHD by either stress SPECT or stress ECHO is the inconclusive clinical results , which cause the referral physician to apply for additional test. The aim of this study was to assess the yield of referral of patients for both stress SPECT and stress ECHO studies.

**Methods**: During 18 months we recruited 71 patients who underwent stress SPECT and stress ECHO or vice versa within 7 months in one medical center. Patients who underwent intervention or acute coronary syndrome were excluded. Clinical variables and results of stress SPECT and stress ECHO were compared.

**Results**: There were 28(39%) women and 43(61%) men aged 66±9. Chest pain was the referral reason for test in 39(55%) and history of CAD in 40 (56%) patients. Echo was performed prior SPECT in 50% and vice versa. Pharmacological stress was done in 32(45%) (Dipyridamole) by SPECT and 12(17%) (Dobutamine) by ECHO. The overall discrepancy between ECHO and SPECT was 52%. Normal study was significantly higher with ECHO than with SPECT (73% vs 45% $p<0.001$); the prevalence of ischemia with and without scar was significantly higher with SPECT than with ECHO (45% vs 11%, $p< 0.001$) and scar/wall motion abnormality was similar (10% vs 13%, p=NS). Of note, 5(7%) patients showed significant ischemia by SPECT, which was not detected by ECHO

**Conclusions**: The rate of discrepancy between SPECT and ECHO results done within 7 months was significantly high. However, only minority had substantial findings that might require further evaluation.

# Left Ventricular Volumes Assessment by Rest Gated Tl-201 SPECT: Comparison with Two-dimensional Echocardiography

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**Background:** Myocardial imaging with thallium-201 is routinely used for perfusion assessment. Although rest gated thallium-201 (Gated-Tl) images are considered to have a low count statistics, this tracer is used for left ventricular assessment. The aim of this study was to compare left ventricular end diastolic volumes (EDV), end systolic volumes (ESV) and ejection fraction (LVEF) obtained on 4 hours rest Gated-Tl with those obtained by two-dimensional echocardiography (2-D ECHO).

**Methods:** The study included 32 patients who underwent a dipyridamole stress-rest gated SPECT myocardial perfusion imaging and 2-D ECHO studies the same day. EDV, ESV and LVEF were evaluated using the Cedars-Sinai Quantitative Gated SPECT (QGS) software package and by 2-D ECHO using the modified Simpson method for comparison.

**Results:** 21 (65.6%) of the patients were men, the mean age was 70.3± 8.2 years old, the incidences of a previous history of CAD and old myocardial infarction were 18 (56.3%) and 8 (25%), respectively. The mean EDV, ESV and LVEF were: 84 ml (range 67-109), 33 ml (range 22-52), LVEF 56±8 % by 2-D ECHO and 93 ml (range 59-113), 38 ml (range 28-56) and 57±10 % by Gated-Tl, respectively. Pearson's correlation co-efficient (r value) for EDV, ESV and LVEF between the two methods were 0.77, 0.74 and 0.62, respectively.

**Conclusions:** A good correlation was found between rest gated Tl-201 MPI and 2-D ECHO for the assessment of left ventricular volumes and ejection fraction. Rest gated Tl-201 provides credible values of left ventricular volumes to be used in routine clinical practice.

# Fully Automatic Calculation of Cardiac Chamber Volumes can be Achieved Accurately from 4D CT Datasets

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**Purpose**: to evaluate the accuracy of a novel algorithm that performs fully automatic segmentation of the 4 cardiac chambers from gated computed tomography (CT) datasets.
**Methods**: 10 patients with acute myocardial infarction (AMI) and 10 normal controls underwent cardiac CT scans on a Philips Brilliance 64 scanner. Four phases (mid- and end-diastole, mid- and end-systole) were evaluated per patient. Immediately after loading the datasets, fully automatic segmentation of the 4 cardiac chambers was performed, using an algorithm based on an anatomical heart model which adapts a 3D mesh to new images exploiting simultaneously knowledge of organ shape and typical gray level appearance in images, learned from a training database. Segmentation of each chamber was then performed manually using volume-based region growing methods. Volumes obtained by each method were compared using Bland-Altman analysis and linear correlation.
**Results**: All chambers in all patients and for all phases achieved successful segmentation. Bland-Altman analysis showed minimal bias (-1.0ml, +0.4ml, -1.8ml) for the left (LV) and right (RV) ventricles, and right (RA) atria, but overestimation of LA volume (+23.6ml) due to inclusion of pulmonary veins. 95% CI were 10.2ml, 2.2ml, 6.5ml, and 10.3ml, respectively and correlation coefficients were all 0.98-0.99. Automatic LV and RV stroke volumes (SV) were also very accurate. As a test of physiological accuracy, left sided SV (89 ± 26ml) correlated highly with right sided SV (82 ± 21ml, r=0.88). Ejection fraction averaged 48 ± 12% for AMI and 58 ± 6% for normals with r=0.91 vs. manual approach.
**Conclusion**: Fully automatic calculation of volumes of all cardiac chambers can be achieved with a very high accuracy over multiple cardiac phases, however LA volume is overestimated.

# ECG Location of Exercise Induced ST-T Shifts may Predict SPECT Perfusion Defects in Patients with Pre-existing CRBBB

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Background – Exercise myocardial perfusion scan is indicated in subjects with CRBBB and medium to high pre-test likelihood to coronary artery disease due to the uncertainty involved in the interpretation of ECG changes during a regular exercise test. Aim: To evaluate the association between ECG leads involved in the depolarization changes and the scintigraphic findings.
Methods: Among 1350 patients patients who underwent myocardial perfusion scan with Tl-201 or Sestamibi MIBI during the period 1.7.04 – 1.2.06, 59 (4.37%) were found to have a pre-existing CRBBB. The location of exercise induced $\geq$ 1mm ST-T shift was categorized as pattern (A) when leads V1-V3 were involved, (B) when II, III, aVF, &V5-V6, (C) when V1-V6, and pattern (D) when no ST-T shift occured. Association with the presence of perfusion defect, its location, age, gender, previous evidence of CAD, angina, and risk factors was assessed.
Results: Pattern A was observed in 7 patients, B in 24 patients, C in 18, and
D in 10 patients. All patients with pattern A (ST-T $\downarrow\downarrow$in V1-3) had normal perfusion scan, patients with pattern B, C, and D had fixed e/o reversible perfusion defects. Pattern A correlated well with no (or one) risk factors ($r= 0.72$, $p<0.05$) while patterns B, C, and D correlated well with $\geq 2$ risk factors ($r= 0.65$, 0.75, and 0.66, respectively, $p<0.05$). Pattern A correlated well with the absence of previous infarction, CABG, or percutaneous intervention, $r = -0.88$, $p <0.01$.
Conclusions: ST-T shifts only in leads V1-V3 during exercise myocardial perfusion scan were found to be associated with normal myocardial perfusion and with absence of coronary risk factors, thus, with low likelihood of coronary artery disease.