ABSTRACTS FROM BNCS DECEMBER MEETING 2006

1. How reliable are gated SPECT measurements of left ventricular volumes and ejection fraction from the low-dose study of a one-day Tc-99m protocol?

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Introduction. Gated SPECT provides accurate measurements of LV volumes and ejection fraction (EF), but reproducibility has mostly been assessed using a relatively large Tc-99m dose. A fall in EF post stress is of prognostic significance, so reproducibility of values from the low-dose part of a 1-day protocol is important.

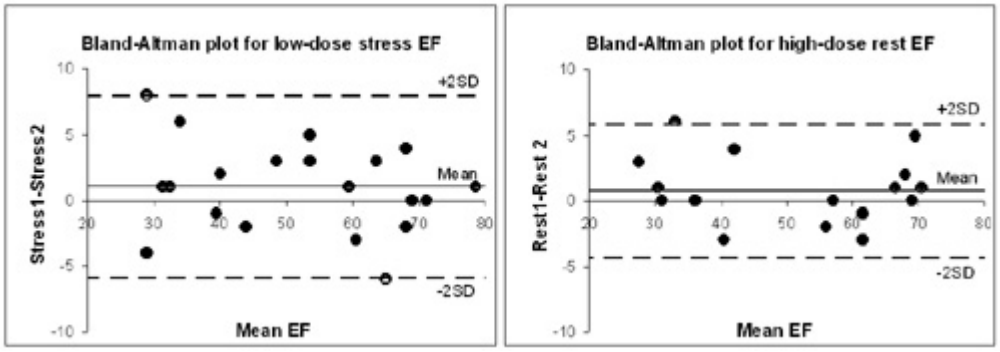
Methods. 20 patients undergoing routine 1-day stress-rest Tc-99m-tetrofosmin SPECT were recruited: male 19, mean age 64(40-76), known coronary disease 16, normal 6 / fixed defect 10 / reversible defect 4. Two separate gated SPECT acquisitions were obtained for both stress and rest parts of the study: 32 projections, 180° contoured orbit, 16 frames per cycle, 20% R-R window. LV volumes and EF were calculated automatically using commercial software (Cedars-Sinai QGS).

Results. Excellent and comparable reproducibilities were found for low-dose stress acquisitions, high-dose rest acquisitions, and between stress and rest acquisitions (Table and Figure).

Conclusions. Reproducibilities of LV volumes and EF measured from a low-dose gated SPECT study are similar to those from a high-dose study. Both acquisitions of a 1-day protocol should be gated.

Table.

	EF (%)		EDV (ml)		ESV (ml)	
	Delta (mean ± SD)	R^2	Delta (mean ± SD)	R^2	Delta (mean ± SD)	R^2
Stress1-Stress2	1.0 ± 3.4	0.96	-1.3 ± 7.1	0.99	-1.3 ± 6.3	0.99
Rest1-Rest2	0.7 ± 2.6	0.98	-4.6 ± 9.2	0.97	-3.9 ± 6.0	0.99
Stress1-Rest1 (reversibles excluded)	-0.6 ± 3.4	0.96	-1.6 ± 13.6	0.96	1.6 ± 8.4	0.98



2. Increased Risk of Abnormal Myocardial Perfusion in Type II Diabetic Subjects Compared to Non-Diabetic Subjects with Similar Levels of Coronary Artery Calcification

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Background. Coronary artery calcification is associated with an increased risk of obstructive coronary artery disease. We have previously documented this risk in a prospective cohort of Type II diabetic patients; however, this risk appears to be significantly higher than reported in cohorts consisting of non-diabetic and diabetic patients in the literature. We hypothesise that Type II diabetes may be responsible for an increased likelihood of obstructive coronary artery disease for any given level of coronary artery calcification.

Methods. Asymptomatic subjects without known coronary artery disesae were recruited from 2 ongoing prospective studies of coronary artery calcification. Subjects were recruited from the community and from a hospital-based Type II diabetic clinic. Subjects with at least 100 Agatston units of coronary artery calcium were invited for a 2 day stress / rest gated Tc99m-sestamibi SPECT myocardial perfusion scan. Dipyridimole and symptom limited treadmill stress was used.

Results. 310 subjects in total were invited. 209 were type II diabetics. Mean age was 58 years, 75% were male. 20% of all myocardial perfusion scans were abnormal. In a multi-variable logistic regression analysis which included all the established cardiovascular risk factors (age, gender, smoking habit, lipid profile, diabetes, blood pressure and history of hypertension) and the coronary artery calcium score, only the coronary artery calcium score and diabetes were independent predictors of abnormal myocardial perfusion (for diabetes, $p = 0.03$, odds ratio 3.1, confidence interval 1.1-8.3).

Conclusion. Type II diabetic subjects appear to have a significantly elevated risk of obstructive coronary artery disease compared to non-diabetic subjects with similar levels of coronary artery calcification, even after adjusting for the established cardiovascular risk factors. This suggests that in Type II diabetic patients, the threshold for performing myocardial perfusion scans in those with elevated coronary artery calcium scores should be reduced compared to non-diabetics.

3. ST elevation in lead aVR during exercise testing should not be ignored.

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Background:
The significance of ST elevation (STE) in lead aVR during exercise is controversial. Lead aVR is directed towards the left ventricular (LV) cavity and so changes may indicate LV dysfunction on exercise. We aimed to assess the diagnostic value of STE in aVR during exercise prior to Tc^{99}-sestamibi scanning and its predictive value in identifying ischemic territory and angiographic findings.

Methods:
Consecutive patients attending for Tc^{99}-sestamibi perfusion imaging between April 2004 and Aug 2004 were enrolled. Patients completed a treadmill protocol. Peak exercise ECGs of these patients were coded by 2 blinded investigators. STE ≥
0.5mm in lead aVR was significant. Gated perfusion imaging results were recorded. Findings at angiography were assessed.

Results:
Of the 557 patients studied, STE in lead aVR occurred in 25% (138) of the patients. More patients with STE in aVR had a reversible defect on imaging compared with those that had no STE in aVR (41% 56/138 vs 27% 114/419, p = 0.003). Defects indicating a left anterior descending artery (LAD) culprit lesion were more common in the STE aVR group (20% 27/138 vs 9% 39/419, p=0.001). There was a trend towards coronary artery stenosis (>70%) in a double vessel distribution involving the LAD in those patients who had STE in aVR compared to those who did not (22% 8/37 vs 5% 4/76, p=0.06)

Logistic regression analysis demonstrates that STE in aVR (OR 1.36 p=0.233) is not an independent predictor of inducible abnormality when adjusted for STD >0.1mV (OR 1.7 p=0.03), however using anterior wall defect as an endpoint STE in aVR (OR 2.77 p=0.008) remained a predictor after adjustment for STD (OR1.4 p=0.281).

Conclusions:
STE in aVR during exercise does not diagnose significantly more inducible abnormalities than STD alone. However, unlike STD which is not predictive of a territory of ischemia, STE in aVR is associated with an anterior wall reversible defect.

4. A phantom study to investigate the effect of arm truncation on attenuation correction of myocardial perfusion SPECT

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Background: The diagnostic outcome of myocardial perfusion imaging is affected by attenuation artefacts. Attenuation correction (AC) removes such artefacts but can introduce distortions due to transmission artefacts such as truncation. However, many cardiac patients have restricted mobility and find the preferred imaging position, with left arm raised, difficult. These patients are imaged with both arms down and AC used to compensate. The arm is often truncated but the effect of this on final images is unclear. This phantom study investigated truncation effects, specifically of imaging with arms down, and assessed AC efficacy.

Method and Results: A Data Spectrum anthropomorphic phantom was used with additional overlying tissue and arms. Three male and three female phantoms of increasing size were imaged, with and without arms, using a GE Millennium VG gamma camera with 'Hawkeye'. AC was most accurate in the small phantoms. The largest phantoms contained more severe attenuation artefacts, with breast attenuation seen in the antero-septal region of the non-corrected images. This was not corrected accurately in the largest phantom possibly due to breast tissue truncation. Quantitative assessment of the uniformity demonstrated that AC efficacy reduced with phantom size. The addition of arms did not have a significant effect on any image, even with severe truncation. This is postulated to be due to the greater distance between the heart and the arms, compared with the truncation effect of proximal breast tissue.

Conclusions: AC was effective in all but the largest phantoms, with no significant effect after the addition of arms. Arm truncation, however severe, caused little effect on myocardial appearance and phantom size, specifically the degree of breast truncation, was more significant. If necessary, patients may be imaged with arms down without compromising AC accuracy. Although reducing resolution, using AC in this context is valid and does not introduce additional artefacts.

5. The Effect of Beta$_1$-Selective Blockade on Adenosine Myocardial Perfusion Scintigraphy

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Introduction: Beta-blockers decrease the extent and severity of inducible perfusion abnormalities seen by dipyridamole myocardial perfusion scintigraphy (MPS) but little is known on their effect when using adenosine vasodilation stress.

Aim: The purpose of this study was to investigate the effect of chronic beta-blockade on adenosine MPS.

Methods: In this crossover study, 50 patients with angiographically significant coronary artery disease (CAD) on regular beta-blocker therapy (atenolol n=37, bisoprolol n=9, metoprolol n=4) underwent adenosine technetium-99m tetrofosmin MPS both on- and off-beta blockade in a random order on separate days. The median (interquartile range) interval between MPS studies was 14 days (5 to 28). Tracer uptake was assessed qualitatively and semi-quantitatively using a five-point, 20-segment model of the left ventricular myocardium. Haemodynamic response and perfusion variables (summed stress [SSS] and summed difference [SDS] scores) were compared between the on- and off-beta blockade studies.

Results: Of 50 patients, 45 (mean ± SD age 62 ± 13 years) completed both MPS studies. Beta-blockade reduced the rate pressure product both at baseline and after 6 minutes of adenosine infusion by 23 ± 15% and 21 ± 18%, respectively ($p<0.001$ for all vs. off-beta blockade). It also reduced the median (interquartile range) SSS from 15 (9 to 20) to 12 (6 to 21, $p=0.005$) and the SDS from 8 (4 to 13) to 6 (3 to 10, $p=0.009$). Adenosine-induced ischaemic ECG changes were abolished in 6 patients and transient left ventricular dilation in 1 patient by beta-blockade.

Conclusion: Beta$_1$-selective blocking medication in patients with CAD undergoing adenosine MPS is associated with a small but significant reduction in the magnitude of myocardial perfusion abnormalities. This may be related to inhibition of adenosine-induced myocardial ischaemia.

6. Myocardial Perfusion Scanning – a Weighty Matter

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Background

Myocardial count density is an important parameter of image quality in myocardial perfusion scanning. Studies with inadequate counts can show artefactual defects leading to incorrect image interpretation.

The incidence of obesity in the general public has increased in recent years and cardiac patients are no exception. To ensure correct myocardial counts in this population is vitally important.

The practice in use in our department was to use a stepwise increase with weight. The original impetus for this study was the observation that several studies causing diagnostic problems had low myocardial counts. In some cases the patient was of relatively normal weight, but high BMI (body mass index).
There are no British or European guidelines relating to ideal myocardial count density. American guidelines recommend maximum myocardial pixel counts of greater than 200 in the anterior projection based on American administered activities.

Method

An audit of myocardial counts was performed on 119 patients referred for myocardial perfusion studies using the American guideline adjusted to reflect lower British activities as a standard. Results were then corrected for type of scanning protocol, delay post injection, and residual activity in the syringe to remove variables other than administered dose.
A new scheme relating administered dose to BMI was put into action and the results re-audited.

Results

A substantial proportion (55%) of studies did not meet the standard. Several studies with particularly low counts had relatively normal weight (70 – 90Kg) but high BMI (greater than 30). Over the whole group, count density showed a stronger correlation with BMI than weight. After the change of procedure an improved count density was seen with an improvement in image quality.

Conclusions

Myocardial count density is an important determinant of final image quality. To ensure adequate count density administered activity should be increased according to BMI rather than weight.