SPECT Flow Quantification and its Application for the Evaluation of Allograft Vasculopathy in Heart Transplant Recipients

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INTRODUCTION

- Cardiac Allograft Vasculopathy (CAV) has become an increasingly important cause of morbidity and mortality in heart transplant recipients given improvement in long-term survival[1,2]; however its diagnosis remains challenging[4].
- CAV, is characterized by endothelial dysfunction, inflammation, and increased intimal thickening resulting in the development of proliferative fibrofatty plaques and degenerative foci[3].
- PET derived Myocardial Blood Flow (MBF) and Myocardial Flow Reserve (MFR) on PET have been shown capable of detecting CAV and providing prognostic information[5]; however, PET is limited in its availability[6].
- We explored SPECT derived MFR for the detection of CAV.

METHODOLOGY

- Heart transplant recipients referred for routine CAV monitoring vasodilator stress myocardial perfusion imaging (MPI) were selected for dynamic imaging on the DSPECT camera
- From 51 heart transplant recipients who completed the Flow Quantification protocol, 38 had available coronary angiogram results within our system for review and were included in this analysis.
- Patient positioning was accomplished with a hand-injected 1mCi Tc-99m sestamibi (MIBI) pre-scan.
- Vasodilator stress, and rest/ stress MIBI injection using an automated syringe pump, were performed with the patient under the camera:
- Data was acquired in list mode and processed on the Cedars-Sinai QCS/QPS platform
- Significant manual adjustments were routinely made to the blood pool and tissue ROI positions in each frame for input and myocardial activity curve derivation. A rate pressure product (RPP) correction was applied to each scan.
- Myocardial Flow Reserve (MFR) < 2.0 was considered abnormal.

OBJECTIVE OF STUDY

Cadium-Zinc-Telluride (CZT) cameras have made the assessment of MBF and MFR possible on the widely available SPECT imaging platform with substantial accuracy and correlation to other modalities including PET and coronary angiography[7-10].

We posit that SPECT flow quantification can be applied to Sestamibi myocardial perfusion imaging for the more accurate identification of coronary allograft vasculopathy in heart transplant recipients.

AIMS

(1) To determine the MFR value cut off value for heart transplant recipients with a known history of CAV via coronary angiogram,

(2) To determine the relative sensitivities and specificities of Sestamibi myocardial perfusion imaging (MPI), Dobutamine stress echo (DSE), and SPECT flow quantification for the identification of CAV in our cohort.

RESULTS

	Coronary Allograft Vasculopathy (n=8)	No Coronary Allograft Vasculopathy (n=30)
Age	64.13 ± 6.97	61.13 ± 13.93
Male Gender	7 (87.5%)	20 (66.7%)
Years from Transplant	11.12 ± 5.93	10.66 ± 4.34
Average Months Since Coronary Angiogram	31.76 ± 26.67	45.43 ± 39.14
Obesity	1 (12.5%)	10 (33.3%)
Smoking		
Former	2 (25%)	9 (30%)
Current	2 (25%)	5 (16.6%)
Never	4 (50%)	16 (53.3%)
Hypertension	7 (87.%)	26 (86.6%)
Diabetes	2 (25%)	18 (60%)
Hyperlipidemia	7 (87.5%)	27 (90%)
Myocardial Perfusion Imaging Interpretation		
Normal	6	30
Infarct	1	1
Ischemia	1	0
Dobutamine Stress Echo Interpretation		
Negative	4	23
Positive	1	1
Non-diagnostic	1	2
Not available	2	5

Table 1: Baseline characteristics for the patients included in this retrospective analysis

	Myocardial Perfusion Imaging (MPI)	Dobutamine Stress Echo (DSE)	Myocardial Flow Reserve (MFR)
Sensitivity	25%	20%	25%
Specificity	97%	97%	93%
PPV	67%	50%	50%
NPV	83%	85%	93%

Table 2: Relative sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for the imaging modalities utilized in this study. The above table assumes an MFR cutoff of 2.0 as normal

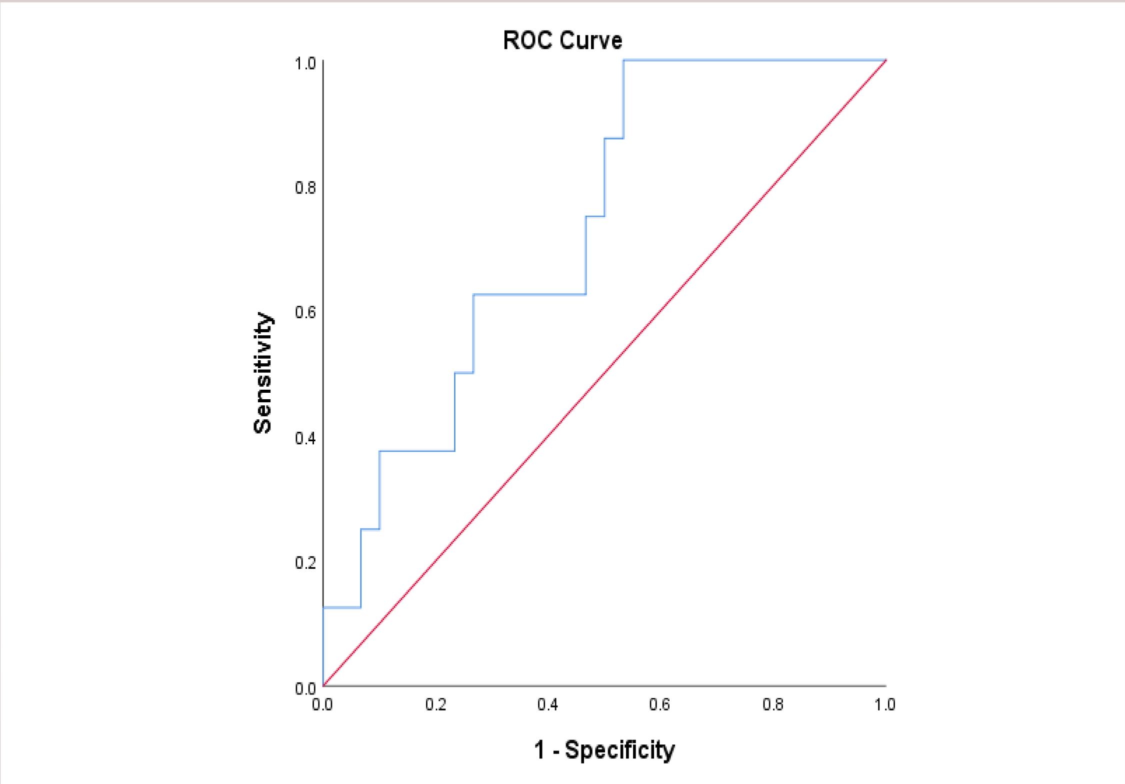

Figure 1: ROC Curve of MFR for prediction of CAV. The optimal MFR cutoff was noted at 2.5 rather than the conventionally held value of 2.0

RESULTS

- Of the 38 patients included in this analysis, 8 carried a diagnosis of CAV
- Global Myocardial Flow Reserve (MFR):
  - MFR was noted to be significantly higher in patients without a history of CAV as compared to those with a history of CAV (2.86 ± .674 v 2.3±.377 , p = .009).
- Peak Stress Flow (PSF) & Rest Flow (RF)
  - PSF values were noted to be higher in patients with a history of CAV, but without statistical significance (2.1 v 2.04, p = .202).
  - RF values were higher in patients with CAV as compared to those without (0.92 v 0.74, p = .021).
- Using a conventional cutoff value of 2.0 as a normal MFR value, Flow quantification yielded a sensitivity of 25% for the process of CAV
- An MFR cutoff value of 2.5, instead of the conventionally held 2.0, yields a sensitivity of 62.5%, false positive rate of 30% and specificity of 70%

CONCLUSION

- Myocardial flow quantification with dynamic SPECT is feasible in heart transplant recipients.
- SPECT derived MFR is lower in patients with CAV compared to those without and seems to be partly driven by higher rest flows.
- SPECT derived MFR may be helpful in the non-invasive evaluation of cardiac transplant patients.
- The optimal diagnostic cutoff for MFR may be different from the non-transplant population.
- Additional studies are needed in order to determine the prognostic value of SPECT flow quantification in patients with a history of CAV.

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DISCLOSURES

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