A Predictive Model for Improved Myocardial Mass Estimation by SPECT

J.B. Moody¹, B.C. Lee¹, V.L. Murthy², J.R. Corbett², E.P. Ficaro¹,²
¹ INVIA Medical Imaging Solutions, Ann Arbor, MI, ²University of Michigan Health System, Ann Arbor, MI

INTRODUCTION

- Left ventricular myocardial mass (LVM) is an important prognostic indicator of cardiovascular risk [1,2,3].
- LVM estimation by SPECT is often inaccurate due to low spatial resolution and partial volume effects.
- In this study we utilize high resolution cardiac CT to develop a statistical model to predict LVM given standard clinical MPS data.

METHODS

- **Patients**
  - Consecutive patients referred to the University of Michigan Medical Center for clinically indicated coronary CT angiography (CTA) and gated myocardial perfusion SPECT (MPS) between 10/2005 and 7/2013 were selected (N=131).
  - Clinically indicated coronary CTA and gated myocardial perfusion SPECT (SPECT) MPS-LVM images were obtained from 105 patients with acceptable quality and complete data were available.

- **Image processing**
  - Coronary CTA images:
    - LVM at end-diastole was estimated using commercial software (Philips EBW).
    - Two estimates were made per patient and the mean used as reference standard (CTA-LVM).
  - Myocardial perfusion SPECT images:
    - Standard MPS processing with LVM estimation (MPS-LVM) using commercial software (Corridor4DM).
    - Standard assumption: mean global myocardial wall thickness at end-diastole was fixed at 10 mm.
    - LV shape parameters based on the myocardial midwall were measured.

- **Statistical Model**
  - A predictive model was developed using multiple linear regression:
    - Response variable: CTA-LVM
    - Predictors: MPS-LVM, patient age, sex, BMI, and several geometric and functional variables derived from LV shape parameters.
  - A sequence of models (shown at right) were computed using the Least Absolute Shrinkage and Selection Operator [4].
  - The models were trained and prediction error assessed using standard repeated 10-fold cross-validation.

RESULTS

- The mean bias between MPS-LVM and CTA-LVM at baseline was 15.9 g with an RMS error of 23.7 g.
- Using the full model (DGF) to predict LVM, the mean bias was reduced to -0.7 g (p<0.0001) with an RMS error of 13.8 g (43% reduction).
- The bias reduction was accompanied by a significant reduction in error variance from 17.7 to 13.9 (p<0.01).
- The number of patients for which the absolute error in the MPS-LVM estimate was greater than 25 g was reduced from 33 to 8.
- This work demonstrates the feasibility of correcting the inherent bias of LV mass estimated by SPECT.
- Future work will extend the models with more training cases and with clinical validation using additional cardiac MR-correlated test data.

REFERENCES