

Post-Stress LV Dilation: The Effect of Imaging Protocol, Gender and Attenuation Correction



J.N. Kritzman, E.P. Ficaró, J.R. Corbett

University of Michigan Health System, Ann Arbor, MI

Objective

- Transient ischemic dilation (TID) has been shown to be a clinically useful marker of severe and extensive coronary artery disease.
- Previous work defined the normal range of TID for the dual isotope protocol. Dependence on isotope, gender and processing parameters was not addressed.
- The objective of this study was to assess the effects of imaging protocol, gender, and attenuation correction (AC) on quantitatively estimated post-stress LV volume ratios.

Methods – Patient Population

- Low likelihood patients and volunteers
- Dual isotope rest Tl-201 / stress Tc-99m sestamibi
 - 30 males
 - 30 females
- Same day rest / stress Tc-99m sestamibi protocol.
 - 20 males
 - 20 females

Methods

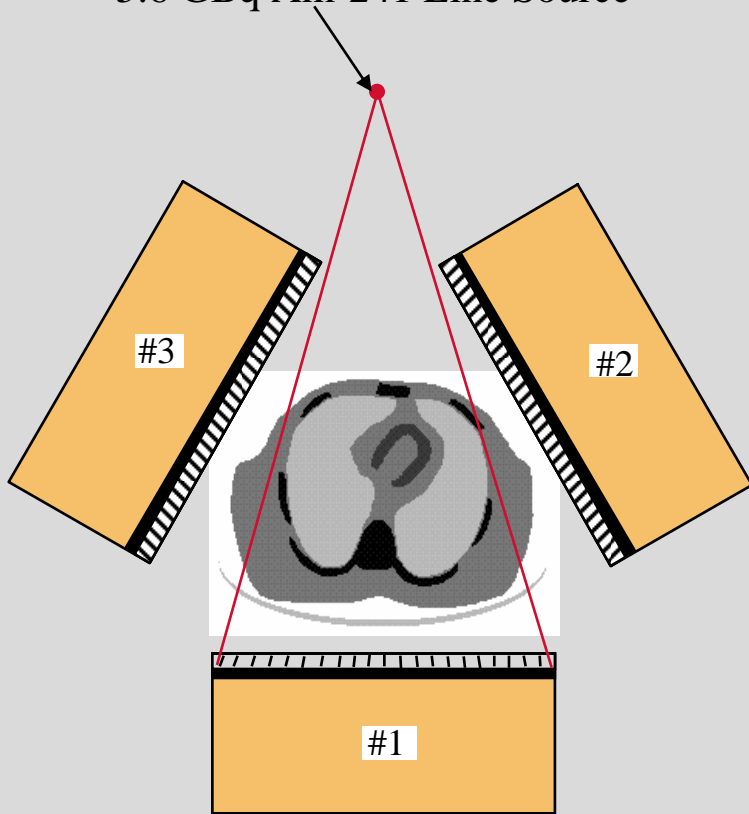
- Dual isotope subjects received 111-148 MBq Tl-201 at rest. 15.91MBq/kg Tc-99m Sestamibi was injected at peak stress.
- Rest/Stress subjects received 370 MBq Tc-99m Sestamibi at rest. 1110 MBq Tc-99m Sestamibi was injected at peak stress.

Methods – Imaging System

- Imaging was performed using modified Marconi 3000XP SPECT systems equipped for simultaneous transmission and emission imaging and attenuation corrected using the Michigan method (M-STEP)

TCT/ECT Acquisition Protocol

5.6 GBq Am-241 Line Source



• Acquisition Geometry

- Marconi Prism XP3000
- Single 65cm LEHRF collimator
- Two LEHRP collimators
- Am-241 (60 keV photons, 460yr $T_{1/2}$)

• Acquisition Parameters

- Tc/Tl Dual Isotope and Same Day Sestamibi Protocol
- 64x64x60, 12-16secs/step over 360°
- Continuous, contouring orbit
- Data collected in emission and transmission windows simultaneously
- Gated study (Simultaneous Acquisition)
 - 16 min, 16 frame gated acquisition

Processing Protocol

- **TRUNCATED TRANSMISSION DATA** - Iterative reconstruction with a penalized, least squares algorithm using a boundary support. Typically 24 iterations -> 1.5 minutes.
- **NC EMISSION DATA** - Filtered backprojection.
- **AC EMISSION DATA** - Iterative reconstruction with measured attenuation map using a penalized, least squares algorithm. Typically 12 iterations - > 1 minute.
- Transaxial images were resliced along short & long axes.

Methods

- Reconstructed image data were quantitatively analyzed for TID using the commercially available 4D-MSPECT software.
- All quantitative results were directly exported from 4D-MSPECT and imported into Excel for tabulation.

Methods

- Stress / rest LV volume ratios were determined in male and female patients using the dual isotope and same day sestamibi protocols.
- Uncorrected (NC) and AC data were analyzed separately.

Results – Dual Isotope

- NC mean normal ratios:
 - Composite = Males = 1.00 ± 0.09 Females = 1.01 ± 0.12
 - 1.01 ± 0.11
 - **Threshold = 1.23 ***
- AC mean normal ratios:
 - Males = 1.02 ± 0.09 Females = 1.03 ± 0.11
 - Composite = 1.02 ± 0.09
 - **Threshold = 1.20**

* Normal Threshold defined as composite + 2 standard deviations

Results – Same Day Sestamibi

- NC mean normal ratios:
 - Males = 0.96 ± 0.07 Females = 1.00 ± 0.07
 - Composite = 0.98 ± 0.07
 - **Threshold = 1.12**
- AC mean normal ratios:
 - Males = 0.99 ± 0.08 Females = 1.00 ± 0.06
 - Composite = 1.00 ± 0.07
 - **Threshold = 1.14**

Results – Validation Group

- Dual Isotope Protocol
 - 117 low likelihood patients
 - Normalcy – 98%
- One day MIBI Protocol
 - 129 low likelihood patients
 - Normalcy = 97%

Conclusions

- The normal ranges of quantitative stress/rest LV volume ratios are unaffected by gender and attenuation correction.
- There was a modest but significant difference in the upper limit of normal based on imaging protocol.