Gender Dependence of Normal Myocardial Perfusion Distributions using the XACT Imaging System

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OBJECTIVE

Multicenter investigation of the differences in radiotracer distributions in normal myocardium as a function of gender with and without attenuation correction using the XACT imaging system (Digirad Corp).

INTRODUCTION

XACT is a new solid-state dedicated cardiac SPECT system employing a novel CT-based attenuation correction (AC), with unique characteristics [1]:

- Ultra-low CT dose (56 gGy)
- Respiratory motion matched to SPECT acquisition
- Integrated 3D-OSEM reconstruction with resolution recovery and scatter correction (nsSPEED) [2]
- XACT has demonstrated improved radiotracer uniformity in the normal myocardium compared to non-corrected (NC) reconstructions.

The purpose of this multicenter study was to determine if XACT attenuation correction eliminates the need for separate male and female normal databases.

METHODS

Patient Population

100 randomly selected patients from 3 U.S. sites who were referred for myocardial perfusion SPECT were evaluated:

- 50 F, Age = 53
- 50 M, Age = 54

Image Acquisition

Emission SPECT data were acquired from all subjects on the XACT system (Digirad Corp) using a standard ASNC rest/stress protocol [2], with 110 M, 210 S and 217 kg/m². SPECT data were acquired in a 144 x 144 x 18 matrix with a 2° slice increment.

Image Processing

All studies were reconstructed using the iterative nsSPEED algorithm with 3D modeling [2].

Non-corrected (NC) and attenuation corrected (AC) images were generated for each study.

Studies were processed in Corridor4DM (INVIA) to generate standard 17-segment polar map images.

Images were evaluated with the following statistical tests:

- Paired Hotelling’s T² test of regional normalized counts (NC vs. AC)
- Unpaired Hotelling’s T² test of normalized counts (male vs. female)
- F-tests of NC and AC regional variances.

RESULTS

Images were evaluated with the following statistical tests:

- Paired Hotelling’s T² test (male vs. female)
- Unpaired tests

Figure 1: Representative rest and stress XACT images from a male (age 44, BMI 29.9) showing a slice-by-slice comparison of normalized and attenuation corrected images. Each row labeled “Rst” or “Str” is non-corrected, and each row labeled “RstAC” or “StrAC” is attenuation corrected. The effects of attenuation correction on count distributions are most noticeable in the inferior and inferolateral walls. (48 x 384, 128 x 128, VLA: vertical long axis)

Figure 2: Representative stress and rest XACT images from a female age 44, BMI 29.9) showing a slice-by-slice comparison of noncorrected and attenuation corrected images. Each row labeled "Rst" or "Str" is non-corrected, and each row labeled "RstAC" or "StrAC" is attenuation corrected. The effects of attenuation correction on count distributions are most noticeable in the inferior and inferolateral walls. (48 x 384, 128 x 128, VLA: vertical long axis)

Figure 3: Normalized count distributions at stress before and after attenuation correction (AC). The difference in regional means before and after AC was significantly different for males (p < 0.001) and females (p < 0.001). In females, normalized counts increased significantly after AC in 17/17 segments (p < 0.001).

Figure 4: Male and female normalized count distributions at stress before (left) and after (right) attenuation correction (AC). The difference in regional means for males and females was significantly different than non-attenuated images (p = 0.002). (Hotelling’s T² test). In males, male and female distributions differed significantly in 7/17 segments (p < 0.001). In females, a similar trend was observed, however the differences were still significant, consistent with previous studies [3].

CONCLUSIONS

- Regional normalized counts increased significantly after attenuation correction for both males and females.
- Gender differences in regional normalized counts were significant in non-attenuation-corrected images.
- After AC, gender differences were reduced in terms of the number of significantly different segments and the magnitude of the differences; however, the differences were still significant, consistent with previous studies [3].
- A trend toward reduced regional variance was observed in both males and females after AC, which was significant in a limited number of segments.
- Although gender equivalence is approached in these results, the AC distributions in males and females currently support the use of separate gender normal databases for the XACT system.

REFERENCES