Combined quantitative supine-prone myocardial perfusion SPECT improves detection of coronary artery disease and normalcy rates in women

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Background. **We sought to determine the diagnostic performance of a recently developed combined supine-prone quantification algorithm for myocardial perfusion single photon emission computed tomography (MPS) for the detection of coronary artery disease (CAD) in women.**

Methods and Results. **Consecutive MPS scans of women without known CAD and coronary angiography within 3 months of MPS (n = 168) and with a low likelihood of CAD (n = 291) were considered. Total perfusion deficit (TPD) was automatically derived for supine (S-TPD), prone (P-TPD), and combined prone-supine (C-TPD) data sets. The low-likelihood patients were grouped by bra cup size (A/B, n = 102; C, n = 101; and D, n = 88). The areas under the receiver operator characteristic curves for S-TPD, P-TPD, and C-TPD were 0.84 ± 0.03, 0.88 ± 0.03, and 0.90 ± 0.03, respectively. C-TPD had a higher specificity than S-TPD and P-TPD for identification of CAD (stenosis ≥70%) without compromising sensitivity (61%, 76%, and 94% for S-, P-, and C-TPD, respectively; *P* < .0005 vs S-TPD and *P* < .05 vs P-TPD). Normalcy rates were higher for C-TPD than for S-TPD or P-TPD.**

Conclusions. **Combined supine-prone quantitative MPS in women yields significantly increased specificity and normalcy rates without compromising sensitivity for the detection of CAD compared with standard analysis. (J Nucl Cardiol 2007;14:44-52.)**

Key Words: Myocardial perfusion imaging • single photon emission computed tomography • image processing • coronary artery disease • image artifacts

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Myocardial perfusion single photon emission computed tomography (SPECT) (MPS) plays an important role in the detection of coronary artery disease (CAD) in women.[1] It is, however, recognized that varying amounts of soft-tissue attenuation from overlying breast tissue pose a technical obstacle in obtaining correct diagnostic results in this population. Attenuation correction techniques theoretically should mitigate this problem and improve the diagnostic accuracy of SPECT in women.[2] Techniques for attenuation-corrected (AC) SPECT and quantitative analysis have been reported to improve detection of CAD[3]; however, these diagnostic results have not been reported specifically in women. One recent study included data on the performance of AC rubidium 82 PET for detection of CAD in a female population.[4]

In a previous study we have reported that combined prone-supine imaging, analyzed with a new automated quantitative algorithm, which combines findings from supine and prone data sets, increases the specificity of MPS for CAD without reducing the sensitivity in a population of both genders.[5] In this study we seek to evaluate the diagnostic performance of this combined prone-supine quantification for MPS in women and to examine the effect of differences in estimated breast size on quantitative breast artifacts.

MATERIALS AND METHODS

The overall study population consisted of 515 female patients (including 40 patients whose data were used for the

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Table 1. Characteristics of patients with low likelihood of CAD

Parameter	Group 1 (n = 40)	Group 2AB (n = 102)	Group 2C (n = 101)	Group 2D (n = 88)
Age (y)	60 ± 13	58 ± 12	58 ± 13	62 ± 23
Body mass index (kg/m^2)	27 ± 6	24 ± 5	26 ± 6	29 ± 7
Hypertension	21 (53%)	26 (26%)	44 (44%)	54 (58%)
Hypercholesterolemia	22 (55%)	37 (36%)	54 (54%)	46 (52%)
Exercise stress	26 (65%)	54 (53%)	51 (51%)*	45 (51%)*

*$P < .05$ versus group 1.

creation of the normal database) who underwent exercise or adenosine stress technetium 99m sestamibi MPS performed in both the supine and prone positions. These were consecutive patients who either had cardiac catheterization less than 3 months after rest thallium 201/Tc-99m sestamibi gated dual-isotope MPS or who had a low likelihood of CAD (<5%) based on age, gender, symptoms, coronary risk factors, and results of rest and stress electrocardiography[6] at the time of MPS. Patients with excessive motion on projection images or areas of excessive extracardiac uptake adjacent to the myocardium on reconstructed images were excluded (n = 16). The data analyzed in this study have been selected retrospectively from the existing database at Cedars-Sinai Medical Center (Los Angeles, Calif). The retrospective use of clinical data in this study was approved by the Institutional Review Board at Cedars-Sinai.

Normal Database Population

Normal limits for both supine and prone acquisitions were defined from a group of 40 female patients with a low likelihood of CAD, comprising group 1 (Table 1), as previously described.[5,7] No patients in this low-likelihood group had diabetes mellitus, angina, shortness of breath, abnormal resting electrocardiographic response, or abnormal stress electrocardiographic response. In this group only, an additional criterion for inclusion was normal rest and poststress MPS images by visual assessment.

Normalcy Population

To obtain normalcy rates, 3 subgroups of female patients with a low likelihood of CAD were analyzed, comprising group 2: 102 consecutive patients with a bra cup size of A or B (group 2AB), 101 with a bra cup size of C (group 2C), and 88 with a bra cup size of D or greater (group 2D) (Table 1).

Angiographic Validation Population

Group 3 consisted of 168 consecutive female patients who had coronary angiography within 3 months of MPS (Table 2). Exclusion criteria were as follows: (1) prior myocardial infarction or coronary revascularization, (2) nonischemic cardiomyopathy or valvular heart disease, and (3) change in symptoms between MPS and coronary angiography.

Table 2. Characteristics of patients with angiography (n = 168)

Parameter	Value
Age (y)	68 ± 11
Body mass index (kg/m^2)	28 ± 6
Hypertension	121 (72%)
Diabetes	42 (27%)
Hypercholesterolemia	91 (54%)
Symptoms	
Asymptomatic	23 (14%)
Nonanginal chest pain	18 (11%)
Atypical angina	80 (48%)
Typical angina	27 (16%)
Shortness of breath	38 (23%)
Exercise test	84 (53%)

Acquisition and Reconstruction Protocols

All patients underwent separate-acquisition rest Tl-201/stress Tc-99m sestamibi dual-isotope MPS as previously described.[8] Poststress Tc-99m sestamibi acquisitions were performed beginning 15 to 60 minutes after injection with a noncircular 180° orbit, with 64 projections at 25 seconds per projection for supine Tc-99m acquisition, followed immediately by 15 seconds per projection for prone Tc-99m acquisition. The rest Tl-201 acquisition was performed at 35 seconds per projection[8] only in the supine position; however, rest images were not used in this study. Images were acquired on a dual-detector camera (Forte or Vertex [Philips Medical Systems, Andover, Mass] or e.cam [Siemens Medical Systems, Malvern, Pa]). High-resolution collimators were used. No attenuation or scatter correction was applied. Studies were reconstructed on the respective vendor platforms (Pegasys [Philips Medical Systems] or e.soft 2000 [Siemens Medical Systems]) by use of their commercial implementations of the iterative reconstruction. The reconstruction parameters were 12