Assessment of global and regional left ventricular function and volumes with 64-slice MSCT: A comparison with 2D echocardiography

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Background. **In patients with coronary artery disease (CAD), LV function and volumes are important parameters for long-term prognosis. Multislice computed tomography (MSCT) allows noninvasive assessment of the coronary arteries, but the accuracy of 64-slice MSCT for the assessment of left ventricular (LV) volumes and function is unknown.**

Methods and Results. **A head-to-head comparison between 64-slice MSCT and 2-dimensional (2D) echocardiography was performed in 40 patients with known or suspected CAD. The LV end-diastolic volume (LVEDV) and LV end-systolic volume (LVESV) were determined and the LV ejection fraction (LVEF) was derived. Regional wall motion was assessed visually using a 17-segment model. A 3-point scoring system was used to assign to each segment a wall motion score: 1 = normokinesia, 2 = hypokinesia, 3 = akinesia or dyskinesia. Two-dimensional echocardiography served as the gold standard. MSCT agreed well with 2D echocardiography for assessment of LVEDV ($r = 0.97$; $p < .0001$) and LVESV ($r = 0.98$; $p < .0001$). An excellent correlation between MSCT and 2D echocardiography was shown for the evaluation of LVEF ($r = 0.91$; $p < .0001$). Agreement for the assessment of regional wall motion was excellent (96%, $\kappa = 0.82$).**

Conclusions. **An accurate assessment of global and regional LV function and volumes is feasible with 64-slice MSCT. (J Nucl Cardiol 2006;13:480-7.)**

Key Words: Multislice computed tomography • left ventricular function • echocardiography

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Assessment of global and regional left ventricular (LV) function and volumes provides valuable information in patients with ischemic heart disease. Furthermore, LV ejection fraction (LVEF) is an important prognostic marker in coronary artery disease (CAD).[1] Noninvasive imaging modalities for the evaluation of global and regional LV function and volumes include single photon emission computed tomography (SPECT),[2] cardiac magnetic resonance imaging (CMR),[3] and 2-dimensional (2D) echocardiography.[4] Over the past years, multislice computed tomography (MSCT) has proven to allow accurate noninvasive assessment of CAD.[5-7] In addition, because MSCT data acquisition is gated to the electrocardiogram, global and regional LV function and LV volumes can be derived from the same dataset. The feasibility of MSCT for the evaluation of LV function has been investigated for 4-slice and 16-slice MSCT.[8-11] However, the accuracy of 64-slice MSCT for the evaluation of global and regional LV function and volumes has not yet been investigated. The recently introduced 64-slice systems have even higher temporal and spatial resolution and allow the acquisition of high-resolution 3-dimensional images of the entire heart in less than 10 seconds. The assessment of global and regional LV function and LV volumes with MSCT, in addition to noninvasive evaluation of the coronary arteries in patients with known or suspected CAD, will optimize the evaluation of patients with CAD.

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The purpose of the present study was to validate the assessment of global and regional LV function and LV volumes with 64-slice MSCT, using 2D echocardiography as the reference standard for these parameters.

METHODS

Patients and Study Protocol

Forty patients with known or suspected CAD underwent 64-slice MSCT to assess potential coronary artery stenoses. The study population consisted of 28 men and 12 women, with a mean age of 60 ± 12 years. Fourteen patients had a history of previous myocardial infarction. A total of 26 (65%) patients used β-blocking agents. Clinical characteristics of the study population are summarized in Table 1.

From the same dataset as used for the evaluation of the coronary arteries, regional LV function, LVEF, and LV volumes were assessed and compared with 2D echocardiography. Two-dimensional echocardiography and MSCT were performed within 1 month of each other. Patients with (supra-)ventricular arrhythmias were excluded, as were patients with renal insufficiency (serum creatinine level, >120 mmol/L) and known allergy to iodine contrast media. All patients provided informed consent to the study protocol, which was approved by the local ethics committee.

Table 1. Clinical characteristics of the study population (n = 40)

Age, y	60 ± 12
Men	28 (70%)
History of myocardial infarction	14 (35%)
Location	
Anterior	10 (71%)
Inferior	2 (14%)
Both*	2 (14%)
Q wave on electrocardiogram	9 (23%)
Multivessel CAD	8 (20%)
Angina pectoris	
CCS class I/II	38 (95%)
CCS class III/IV	2 (5%)
Heart failure	
NYHA class I/II	37 (93%)
NYHA class III/IV	3 (8%)

CCS, Canadian Cardiovascular Society; *NYHA,* New York Heart Association.
*Two patients had 2 previous myocardial infarctions.

MSCT

Data acquisition. MSCT examinations were performed with a 64-slice Toshiba Multi-slice Aquilion 64 system (Toshiba Medical Systems, Otawara, Japan). Collimation was 64 × 0.5 mm and rotation time was 400 or 450 ms, depending on heart rate. Tube current and voltage were 300 mA and 120 kV, respectively. The total amount of contrast (Iomeron 400; Altana, Konstanz, Germany) was 80 mL, followed by a saline flush of 40 mL. To time the scan, automated detection of peak enhancement in the aortic root was used. All images were acquired during an inspiratory breath hold, whereas the electrocardiogram was registrated simultaneously for retrospective gating of the data. To assess LV function and LV volumes, 5.0-mm slices were reconstructed in the short-axis orientation at 20 time points, starting at early systole (0% of cardiac cycle) to end-diastole (95% of cardiac cycle) in steps of 5%. Consequently, images were transferred to a remote workstation with dedicated cardiac function analysis software (CMR Analytical Software System; Medis, Leiden, The Netherlands).

Data analysis. To determine LV function, an independent observer outlined endocardial borders manually on the short-axis cine images. The papillary muscles were regarded as being part of the left ventricular cavity. The LV end-diastolic (LVEDV) and LV end-systolic (LVESV) volumes were calculated and the LVEF was derived by subtracting the end-systolic volume from the end-diastolic volume and dividing the result by the end-diastolic volume. The regional wall motion was assessed visually, using the short-axis slices, by 2 observers blinded to all other data using a 17- segment model.[12] A 3-point scoring system was used to assign to each segment a wall motion score: 1 = normokinesia, 2 = hypokinesia, and 3 = akinesia or dyskinesia. For reconstruction of the scan in short-axis cineloops, subsequent delineation of the endocardial contours, and analysis of LV volumes and regional function, approximately 15 to 20 minutes was needed.

2D echocardiography. For comparison of LVEF and LV volumes, harmonic 2D echocardiography was performed. Patients were imaged in the left lateral decubitus position with a commercially available system (Vingmed Vivid-7; GE-Vingmed, Milwaukee, Wis). Images were acquired using a 3.5-MHz transducer at a depth of 16 cm in the parasternal view and apical 2- and 4-chamber views. From the apical 2- and 4-chamber views, the LV volumes were derived and LVEF was derived using the biplane Simpson's rule.[13] Regional wall motion was scored using the same 17-segment model and 3-point scoring system as described for MSCT. LV function was assessed by an experienced cardiologist who was blinded to the results of MSCT.

Statistical Analysis

Continuous data are expressed as mean ± standard deviation (SD). Agreement for LV volumes and global LV function by MSCT and echocardiography was determined by Pearson's correlation coefficient and the Bland-Altman analysis.[14] The 95% limits of agreement were defined as the range of values ± 2 SDs from the mean value of differences. Agreement between findings on 2D echocardiography and MSCT for the assessment of regional LV function was calculated and κ values were determined (<0.4, poor agreement; 0.4-0.75, fair to good; >0.75, excellent).[15] A *p* value of less than .05 was considered statistically significant.

RESULTS

LVEDV

The mean LVEDV was 159 ± 54 mL (range, 97-343 mL) on 2D echocardiography, as compared with 157 ± 59 mL (range, 73-336 mL) on MSCT. An excellent corre-