M-mode Echocardiography Over-estimates Left Ventricular Mass Compared With Magnetic Resonance Imaging

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Introduction and Purpose

Echocardiography is routinely used for determination of left ventricular mass (LVM) in patients and in study subjects. The reported values in studies using echocardiography are higher than when magnetic resonance imaging (MRI) is used (1, 2). These studies have been using a gradient echo sequence. Alfakih et al presented lower normal values for LVM when using steady state free precession sequence (SSFP) compared with the older GRE sequence (3). The first aim of the present study was to compare, in the same subjects, LVM calculated from echocardiography (using routine convention and formula) to LVM determined by magnetic resonance imaging (MRI) using a SSFP sequence used as a gold standard (4). The second aim was of this study was to investigate whether a larger size in LVM determined by echocardiography compared to MRI is due to the used formula or measurements underlying the calculation.

Method and Materials

MRI and echocardiography was performed on 236 subjects (118 males, 118 females), who were recruited at seventy years of age. Echocardiography was performed with an Acuson XP124 cardiac ultrasound unit (Acuson, California, USA) using a 2.5 MHz transducer for the majority of the examinations. LV dimensions were measured with M-mode on-line from the parasternal projections, using the leading edge to leading edge convention. Measurements included interventricular septal thickness (IVS), posterior wall thickness (PW), left ventricular diameter in end diastole (LVEDD,). LVM was determined using the Penn conversion modified 1986 by Devereux et al.

MRI was performed on a 1.5 T Gyroscan Intera System (Philips Medical Systems, Best, the Netherlands) using the standard five-element cardiac coil and a SSFP cine sequence covering the left ventricular myocardium in 8 mm thick short axis slices with 2.5 mm slice gap. Endocardial and epicardial contours were semi-automatically segmented in the end-diastolic and end-systolic frames. The workstation ViewForum (Philips Medical Systems, Best, the Netherlands) then calculated the LVM using Simpson's rule approximation. In 229 of the subjects, IVS, PW, LVEDD, could be measured on the MR-images, using a leading edge to leading edge convention and LVM was also calculated from these measurements using the Penn conversion modified by Devereux et al. 1986 and 1977.

Results

LVM (mean (g) ± standard deviation) determined in men (135.3 ± 28.7) and women (90.4 ± 20.5) was comparable to previously reported values (3). Using echocardiography, LVM values were significantly higher, 201.8 ± 60 in men and 155.1 ± 48.4 in women. The differences (echocardiography – MRI) were 66.0 ± 45.5 (max 215.6) and 61.1 ± 31.6 (max 127.8), respectively.

When using the 1986 formula, MRI (Penn) and Echocardiography (Penn) correlated to MRI (Simpson's) with an R^2 of 0.647 and 0.457, respectively. Using the values derived from MR, the formula from 1977 resulted in a significantly higher slope value than when the 1986 formula was used. This resulted in increasing overestimation of the LVM with increasing LVM.

Conclusion and Discussion

M-mode echocardiography over-estimates LVM compared with MRI. The measurements derived from echocardiography could be improved (R^2 increased from 0.457 to 0.647) by using measurements from MR, but R^2 was still far from 1. Thus, the larger size in LVM determined by M-mode echocardiography compared to MRI is due to both the used formula and the measurements underlying the calculation.

The higher mean and variability may be a draw-back in clinical and scientific use of LVM determinations based on echocardiography compared to MRI. M-mode echocardiography may be improved both in the used formula and how the measurements are done. Use of real time 3D echocardiography may remove these draw-backs in M-mode echocardiography.

References

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