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Differences in left ventricular ejection fraction using teichholz formula and volumetric methods by cmr: implications for patient stratification and selection of therapy

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Introduction

Left ventricular ejection fraction (LVEF) is important for characterization and management of patients and selection of therapy. The Teichholz formula, Vol = $7D^3/(2.4+D)$, is widely used, as it calculates LV volume using only LV diameter (D), but its accuracy depends on the accuracy of geometric assumptions about LV shape. Volumetric cardiac magnetic resonance (CMR) is accurate and reproducible for determination of LV volumes and EF, and does not require geometric assumptions.

Purpose

We sought to determine whether patients would be classified differently based on EF by volumetric (volEF) vs. Teichholz (tEF) methods.

Methods

262 adults (ages 23-85, 148 men) who underwent CMR (Philips, 1.5 T) for clinical assessment of LV function during 2007-2008 were studied. Imaging included contiguous multislice cine SSFP encompassing the left ventricle in the short-axis orientation for LV systolic function. LV endocardial contours were manually segmented at end-diastole and end-systole. LV volumes were determined by summation of disks to calculate volEF. For Teichholz, D was measured from the LV short-axis slice just basal to the papillary muscle tips at end-diastole and end-systole, using the same cardiac phases selected for volumetric analyses. VolEF and tEF were compared by paired *t* test to determine whether the 2 measures differed over the study population. To assess the impact of each method of determining EF on patient classification, we tabulated the number of changes between categories of EF (Normal ≥0.55; Impaired 0.55 > EF ≥0.35 and Severely Impaired EF < 0.35) by volEF vs. tEF.

Results

Overall, VolEF = 0.54 ± 0.13 [range 0.14 to 0.78] did not differ from tEF = 0.54 ± 0.15 [0.05 to 0.87], p = 0.89. However, the Teichholz method identified more patients as having decreased EF than did volEF (Table, top rows). Further, 77 of 262 patients (29%) changed EF category between tEF and volEF; among these patients, tEF was more likely to assign a patient to a lower (worse) EF category than volEF as shown in the bottom rows of Table 1.

Conclusion

Left ventricular ejection fraction determined by Teichholz and volumetric methods did not differ on average, but 29% of subjects were assigned to a different EF category when comparing tEF to volEF, which has implications for selection of therapy. Although volumetrically-determined LVEF is more accurate and reproducible than Teichholz EF, further work is needed to determine whether volumetric EF provides additional value for clinical decision making.

Table 1:

Subjects classified by ejection fraction and number of EF-category changes			
No. of Subjects	**Normal**	**Impaired**	**Severely Impaired**
volEF **tEF**	175 139	59 88	28 35
Number of EF Category Changes			
tEF $\geq$ **0.55, volEF < 0.55** **15**	tEF < 0.55, volEF $\geq$ 0.55 47	tEF $\geq$ 0.35, volEF < 0.35 4	tEF < 0.35, volEF $\geq$ 0.35 11