Poster presentation

Automated segmentation of routine cine-CMR for volumetric assessment of presence and severity of left ventricular diastolic dysfunction

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Objective
To compare automated volumetric segmentation of routine cine-CMR to echocardiography (echo) for assessment of LV diastolic function.

Introduction
DD alters LV relaxation and compliance, thereby changing timing profiles of LV filling. Cine-CMR provides volumetric data concerning LV filling but is not widely used to assess DD as manual planimetry of all images across all temporal phases requires tracing over one hundred images per exam. Thus, whereas cine-CMR is a reference for systolic function, additional testing using echo is typically necessary to identify DD. We tested whether automated segmentation of routine cine-CMR could be used to stratify presence and severity of DD.

Methods
The population consisted of consecutive post-myocardial infarction patients who prospectively underwent CMR (1.5 T, SSFP) and echo within 1 day. CMR and echo were independently interpreted. Echo was the reference for DD (graded using American Society of Echocardiography criteria). Cine-CMR assessed LV filling using our group's previously validated automated segmentation algorithm (LV-METRIC) - volumetric segmentation of all LV short-axis slices across all temporal phases generated a volumetric-filling profile. Three parameters were tested: <u>Peak Filling Rate</u> (PFR) - maximal Ävolume/Äphase. <u>Time to Peak Filling Rate</u> (TPFR) - interval between end-systole and peak filling. <u>Diastolic Volume Recovery</u> (DVR) - proportion of diastole required to recover a given percent (80%) stroke volume.

Results
113 patients were studied (57 ± 13 years, 43%HTN, LVEF = 54 ± 13%). 64% had echo-evidenced DD (25% grade 1, 63% grade 2, 12% grade 3). LV-METRIC successfully generated LV filling curves (190 ± 36 images/exam) in 99% patients (1 = arrhythmia). Patients with DD had longer DVR (73 ± 13 vs. 66 ± 16%, p = 0.01), longer TPFR (239 ± 164 vs. 177 ± 123 msec, p = 0.03), and a trend towards lower PFR (234 ± 83 vs. 265 ± 77 ml/sec, p = 0.07) vs. those without DD by echo. TPFR by cine-CMR correlated with echo deceleration time by echo (r = 0.25, p = 0.02). In multivariate analysis, echo-evidenced DD was independently associated with DVR (OR 1.36 per 10 point increment [CI = 1.04-1.69] p = 0.03) after controlling for LVEF (OR 1.48 per 10 point decrement [1.02-1.95] p = 0.04), and HTN (OR 3.07 [1.21-7.83], p = 0.02) [model χ^2 = 16.3; p = 0.001]. CMR filling parameters also stratified severity of DD, as evidenced by a stepwise DVR decrease (Figure 1A) and PFR increase (1B) from grade 1 to grade 3 echo-assigned DD grade (both p < 0.001).
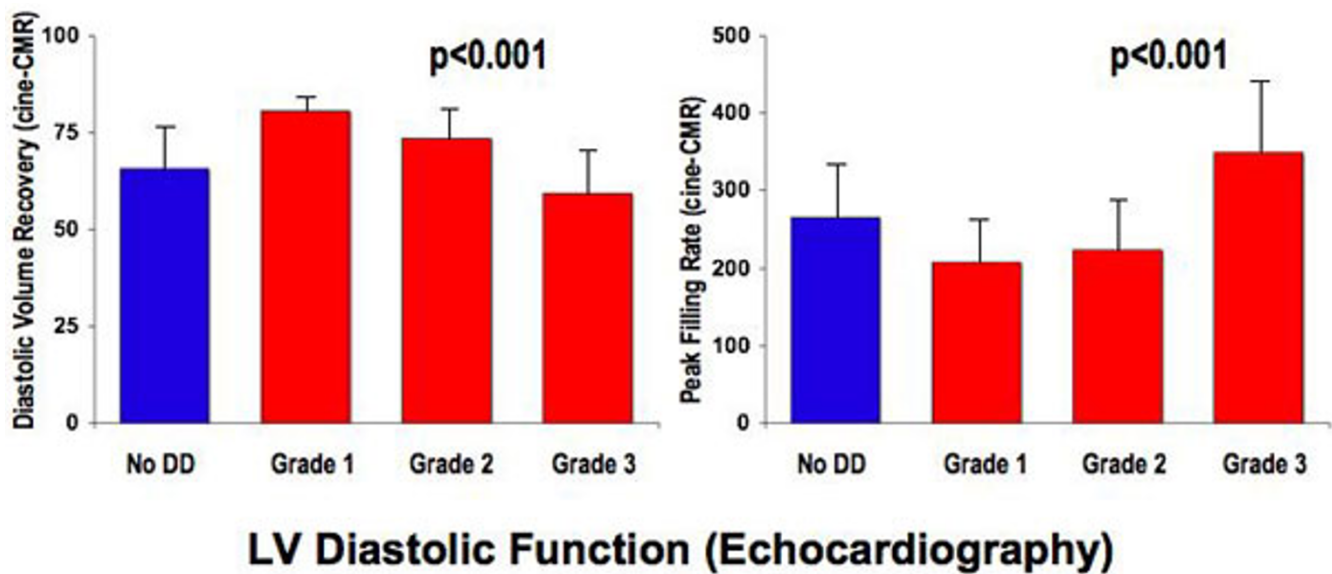
Figure 1
LV Diastolic Function (Echocardiography).

Conclusion

DD changes in LV filling can be detected using automated segmentation of routine cine-CMR without any additional data acquisition. Cine-CMR diastolic filling time and peak filling rate identify presence and stratify severity of echo-evidenced DD.