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Poster presentation

Feasibility of regional left ventricular endocardial curvature analysis from cardiac magnetic resonance images

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Introduction

Left ventricular (LV) remodeling is usually assessed using changes in LV volume. Because this methodology describes only global effects of remodeling while disregarding changes in ventricular shape that may occur independently of volume, the importance of shape analysis is increasingly recognized. While most previous studies focused on global LV shape, we hypothesized that 3D analysis of regional endocardial curvature could provide clinically useful information on localized remodeling.

Purpose

To test the feasibility of applying this approach to cardiac magnetic resonance (CMR) images and to investigate regional differences in endocardial curvature in normal and hypokinetic ventricles.

Methods

We studied 38 patients: 14 with normal LV function (NL), 6 with idiopathic dilated cardiomyopathy (IDC), and 18 with wall motion abnormalities secondary to ischemic heart disease (IHD). Steady-state free precession images (Siemens 1.5 T) were obtained in short-axis views from base to apex as well as 2-, 3- and 4-chamber views. After endocardial boundaries were initialized in the long axis views, LV endocardial surface was semi-automatically reconstructed throughout the cardiac cycle (LV Analysis MR, TomTec). Custom software was used to calculate for each point on the surface the maximum curvature and the curvature in the perpendicular direction, and local surface curvedness (C) was calculated as the root mean square. C values were averaged using standard 17-segment model and compared between groups of segments: NL (N = 401), IDC (N = 98) and IHD (N = 153) using one-way ANOVA.

Results

In all normal segments, C gradually increased during systole and then decreased during diastole (figure). While both maximum and minimum values of C were comparable in the 6 basal and 6 mid-ventricular segments, they were significantly higher in the 4 apical segments and highest in the apical cap. Additionally, percent change in C was higher in mid and apical compared to basal segments ($p < 0.05$). At all LV levels, C values in IDC segments were lower ($p < 0.05$) than in NL and IHD segments, which were similar. In contrast, percent change in C was significantly lower in both IHD and IDC segments compared to NL, Figure 1.

Conclusion

This is the first study to test the feasibility of 3D analysis of regional LV endocardial curvature from CMR images in a relatively large number of patients with different patterns of wall motion. Our results indicate that this approach provides quantitative information on regional ventricular function, which is consistent with the known pathophysiology, and may thus prove clinically useful in the evaluation of LV remodeling.

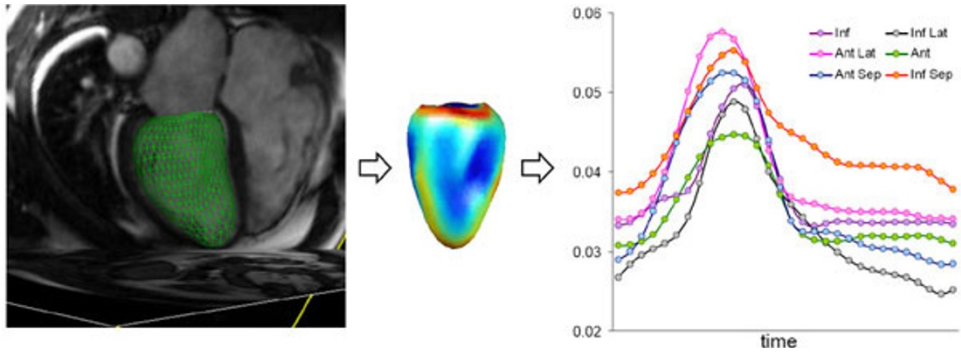

Figure 1