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Meeting abstract

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2081 Characterization of dysfunction in LVH with tagged MRI

Leon Axel*, James Babb, Ting Chen, Sohae Chung, Melissa Guillaume and Monvadi B Srichai

Address: NYU Medical Center, New York, NY, USA

* Corresponding author

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Introduction

Patients with left ventricular hypertrophy (LVH) can have reduced contractile function of the heart wall, even in the setting of normal measures of global function such as ejection fraction, as has been previously demonstrated with tagged MRI of end systolic strain. Tagged MRI provides direct tracking of the motion of material points in the heart wall, and permits calculation of both strain and strain rate of the myocardium, and their temporal evolution. In particular, we can use various variables derived from their evolution to characterize the time course of the development and relaxation of contraction during systole and diastole in LVH; this has not been previously characterized.

Purpose

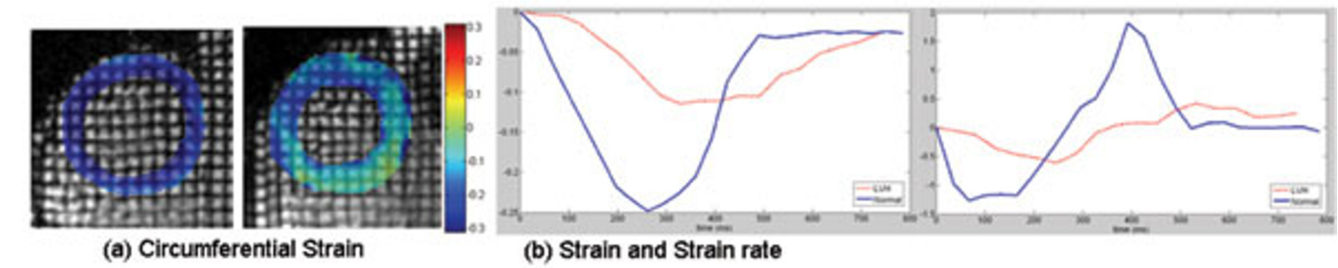
To evaluate the significance of differences in the evolution of strain and strain rate between LVH and normal subjects.

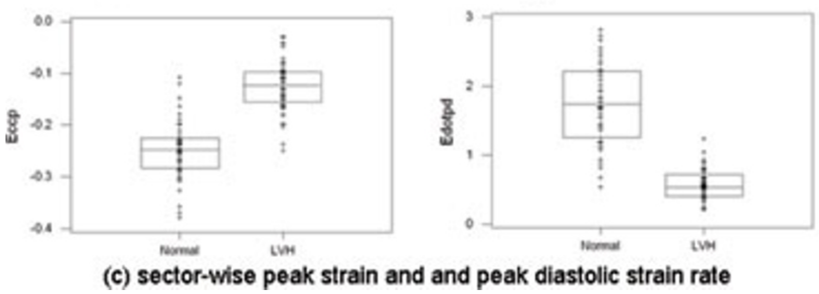
Methods

Tagged cine MRI was performed at 3 T (Siemens Trio) on 3 normal subjects and 4 asymptomatic LVH patients, at 3 short axis levels and 3 long axis planes. Image analysis included extraction of serial tag positions within the heart wall, using Gabor filter banks and active contours, and calculation of corresponding in-plane strain and strain rate values in systole and early diastole, using laboratory-written software. Circumferential strain and strain rate data were used to find (absolute) peak values of strain and strain rate in systole and diastole, and related variables characterizing the rates of development and relaxation of strain, such as the time of the peak rate values, the fraction of the corresponding portion of the cardiac cycle to achieve the peak value, and the fraction of the peak strain value achieved at one half of the portion of the cycle. The results were pooled by sector for the short axis images, and differences between normal and LVH subjects were tested for significance with mixed model regression.

Results

Representative analysis results are shown in Figure 1, including: **(a)** end-diastolic short-axis tagged images with superimposed colors representing end-systolic circumferential strain are shown for normal (left) and LVH (right) subjects, **(b)** graphs of the time course of strain (left) and strain rate (right) are shown for normal and LVH subjects, **(c)** box plots are shown of sector-wise peak (end-systolic) strain (left) and peak diastolic strain rate (right) for normal and LVH subjects. Even with the limited number of subjects in this pilot study, there were significant ($p < 0.05$) differences between normal and LVH subjects in the values of several variables, as illustrated in the Table: peak strain (Eccp), strain at mid-systole (Eccms), peak systolic strain rate (Edotps), peak diastolic strain rate (Edotpd), and fractions of diastole (TedotpdTd) and systole of the times of peak strain rate, and the time of achieving half of the peak strain in diastole; the fractions of peak strain of strains at mid-systole and mid-diastole showed strong trends of difference, but did not quite achieve statistical significance.





Measure*	LVH	Normal	P Value
Eccms	-0.060 ± 0.03	-0.150 ± 0.03	<0.0001
Eccp	-0.120 ± 0.05	-0.250 ± 0.06	<0.0001
Edotpd	0.580 ± 0.21	1.670 ± 0.56	<0.0001
Edotps	-0.630 ± 0.18	-1.350 ± 0.26	<0.0001
TedotpdTd	0.240 ± 0.12	0.170 ± 0.05	<0.0001

Table 1

Figure 1
Tagged MRI provides tracking of the motion of material points in the heart wall, and permits calculation of strain and strain rate and their temporal evolution. Strain rate and development and recovery of strain are significantly altered in LVH patients.

Conclusion

Both the peak values and the time evolution of circumferential wall strain and strain rate are significantly altered in LVH, with slower systolic development and diastolic relaxation of strain compared to normal subjects. These parameters may help predict which patients are likely to develop heart failure symptoms related to LVH, and can potentially guide therapy for patients with underlying LVH.