Utility of Multi-slice T1 Mapping by using Slice Interleaved T1 (STONE) Sequence for the Detection of Diffuse Myocardial Fibrosis in Patients with Hypertrophic Cardiomyopathy

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Target Audience

Scientists and clinicians who are interested in myocardial T1 mapping.

Purpose/Introduction

There have been conflicting reports on the presence of abnormal T1 or extra-cellular volume (ECV) in patients with hypertrophic cardiomyopathy (HCM) [1, 2]. In HCM patients, there are significant regional variations in wall thickness and fibrosis, which necessitates a volumetric coverage. However, current T_1 mapping sequences allow only a single slice per breath-hold, therefore for a full coverage of LV for T1 and ECV mapping with 10 slices, 20 breath-holds are needed. This results in significant burden to the patients and significant additional scan time. We have recently developed a free-breathing slice-interleaved T1 (STONE) mapping sequence, which allows T1 mapping with complete coverage of LV during free-breathing in 1:30 min [3]. The aim of this study was to assess the utility of STONE sequence for detection of regional native T_1 abnormality in HCM patients.

Materials and Methods

Thirteen known HCM patients (mean age: 57 ± 16 years-old, 9 male) were included in the current study. By using 1.5T MR scanner with a 32-channel cardiac receiver coils, we acquired cine MRI, late gadolinium enhanced (LGE) MRI and native T1 mapping by STONE sequence (segmented bSSFP imaging readout with following parameters: 5 slices, TR/TE=2.8/1.4 msec, flip angle=70, FOV=360x351mm^2, voxel size=2.1x2.1 mm^2, slice thickness=8 mm, TFE factor=86, SENSE factor=2). We measured native T1 time of 16 myocardial segments from 3 slices (basal-, mid- and apical-slice) by using in-house developed software (MediaCare). We visually evaluated the presence or absence of myocardial enhancement on LGE MRI. Elevated T1 time was defined as >1130 msec, which was +2SD of native T1 time by STONE sequence in healthy volunteer (mean T1 time in healthy volunteers: 1090 ± 20 msec).

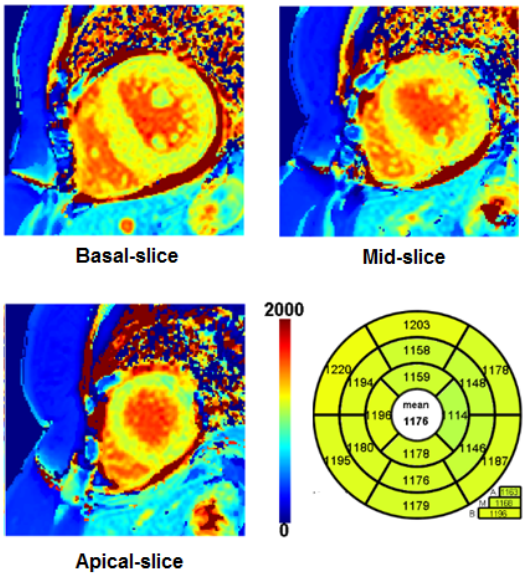

Figure 1. *Multi-slice native T1 mapping images by using STONE sequence in a HCM patient.*

Results

Left ventricular ejection fraction was 66 ± 7% and LV mass was 149 ± 47g. Myocardial enhancement was found in 13 segments from 3 patients on LGE MRI. Mean T1 time of segments with enhancement on LGE MRI was 1163 ± 40 msec. Of 195 segments without enhancement on LGE MRI, 74 (38%) segments showed elevated T1 time. Mean T1 time of 74 segments with elevated T1 time was 1178 ± 37 msec, which was similar to T1 time of 13 segments with enhancement on LGE MRI (1178 ± 37 msec vs 1163 ± 40 msec, p=0.14). Of 74 segments with elevated T1 time, 24 (32%) segments were located in basal-slice, 31 (42%) segments in mid-slice and 19 (26%) segments in apical-slice, respectively.

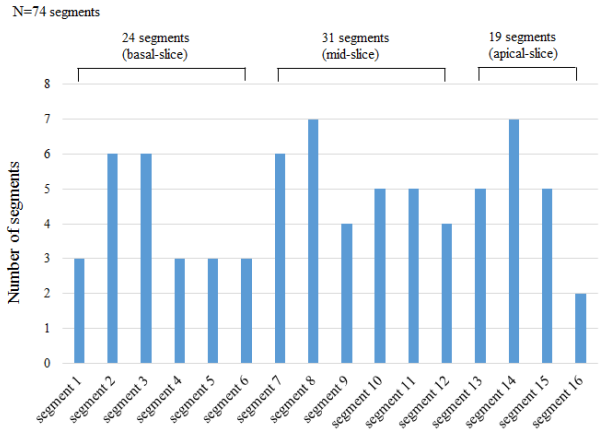

Figure2: *Distribution of segments with elevated T_1 time on 16 segment-model in HCM patients.*

Conclusions

Our data suggests that substantial number of segments with elevated T1 time in HCM patients would be missed by single-slice T1 mapping approach. Multi-slice T1 mapping by using STONE sequence could be advantageous to overcome limited cardiac coverage of conventional single-slice T1 mapping technique and to accurately detect the diffuse myocardial fibrosis in HCM patients.

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References

[1] Puntmann et al., JACC cardiovascular imaging, 2013, [2] Brouwer et al., JCMR 2014, [3] Weingärtner et al., MRM, 2014