Spatial variability in cardiovascular magnetic resonance myocardial T2-mapping

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Target audience
This submission is aimed at physicians and researchers with interest in cardiac imaging and cardiac pathology.

Background/objective
Cardiovascular magnetic resonance (CMR) T2-mapping has potential for the detection and quantification of myocardial edema but the variability and potential pitfalls in broad application are unknown. The mean T2 relaxation time of normal myocardium has been reported around 52-55 milliseconds (ms), with most measurements performed in the mid-ventricle slice.[1, 2, 3] We hypothesize that there is no single best T2 value for the myocardium and this varies between the basal, mid-ventricle and apical slices. The aim of the study was to assess the slice variability of myocardial T2 values in a group of healthy volunteers.

Methods
Healthy volunteers (n=18, 31±8 years old) underwent CMR at 1.5 T. For comparison, consecutive patients (n=40, 36±14 years old) with acute myocarditis, seen for CMR assessment between January 2011 and January 2013, were also analyzed. T2 maps using a T2-prepared single-shot steady state free precession (SSFP) acquisition with three T2-prep echo times: 0, 24, and 55 ms were generated. Short axis T2 maps through the base, mid-ventricle, and apex were obtained in 8, 18 and 7 volunteers, respectively. All 40 patients had three T2 maps each (base, mid-ventricle, and apex). Global myocardial T2 values were obtained on each slice by drawing regions of interest. Global T2 values measured on the base, mid and apical slices in the volunteers were compared. Receiver operating characteristic (ROC) curve analysis using T2 values of volunteers and patients was performed to determine the threshold T2 value that best differentiates volunteers (true negative) and patients (true positive), and sensitivity and specificity values were reported.

Results

In volunteers, the mean global myocardial T2 value was significantly different ($p<0.05$) between the base (50.2±2.8), mid-ventricle (52.1±2.6), and apical slices (55.7±3.8). T2 values increased from the base to the apex. The coefficient of variation of T2 values is the lowest in the mid-ventricle slice (4.96%) and highest in the apex (6.84%).

Applying ROC curve analysis to the volunteer (true negative) and patient (true positive) data, threshold T2 values were estimated at 51.3 ms, 53.7 ms, and 59.6 ms for base, mid-ventricle and apical slices, respectively. With these threshold values, sensitivity and specificity for detection of global edema in acute myocarditis approached 78% and 63% in the base, 65% and 83% in the mid-ventricle, and 75% and 57% in the apical slice, respectively.

Discussion/Conclusion

With the SSFP-based T2 mapping technique, normal global T2 values vary based on slice selection and increase from the basal to the apical slice. Therefore, the use of a single best normal global T2 value for the entire myocardium should be viewed with caution. The mid-ventricle is the most reliable slice for T2 quantification with the lowest coefficient of variation and also the most specific for detection of global edema.

References

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