T2 mapping for the detection of myocardial edema in patients with acute myocarditis

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

Background/Objective

Myocardial edema is used as one of the three recommended cardiac magnetic resonance (CMR) criteria for diagnosing acute myocarditis.[1] Conventional short-tau-inversion-recovery (STIR) sequence for edema imaging is semi-quantitative at best requiring a reference structure.[1, 2,3] The low signal to noise ratio and artifacts related to motion and slow flow also limit STIR imaging.[2, 3] T2-mapping may open the way for a truly quantitative approach in assessing myocardial edema. The aim of the study was to assess the utility of T2 mapping in detecting myocardial edema in patients with acute myocarditis.

Methods

Healthy volunteers (n=18, mean age 31±8 years) and consecutive patients (n=40, mean age 36±14 years) with acute myocarditis diagnosed using clinical and CMR criteria between January 2011 and January 2013 were studied. CMR studies included STIR images as well as T2 maps using a T2-prepared single-shot steady state free precession SSFP acquisition with three T2-prep echo times: 0, 24, and 55 milliseconds (ms). Three short axis T2 maps, one each through the base, mid-ventricle and apex, were obtained. Global and segmental (16 segments) myocardial T2 values were obtained on each slice using regions of interest. T2 values of patients were compared with those of volunteers on the same slice location. STIR images was analyzed using the standard skeletal muscle reference and a ratio of 2.0 was used as a criterion for edema.[1,3] T2 values in patients with segments showing edema on STIR, segments without edema on STIR, as well as T2 values of volunteer myocardial segments were compared to each other.

Results

A total of 120 image slices (640 segments) in patients and 33 image slices (184 segments) in volunteers were analyzed with T2 mapping. Of the 824 total segments, 23 segments had to be excluded from STIR analysis due to poor image quality. The slice-based global T2 value (ms) in acute myocarditis patients was significantly higher than those in volunteers, in the basal (54.4±4.9 vs. 50.2±2.8, $p<0.05$), mid-ventricle (55.8±5.1 vs. 52.1±2.6, $p<0.05$) and apical slices (59.6±6.2 vs. 55.7±3.8, $p<0.05$). Segments with edema on STIR showed significantly increased ($p<0.05$) mean T2 value (57.4±6.6 ms) compared to segments without edema on STIR (55.9±6.6 ms) and volunteers (51.0±6.6 ms). Mean T2 value of segments in acute myocarditis patients without edema on STIR was significantly higher than those in volunteers (55.9±6.6 ms vs. 51.0±6.6 ms, $p<0.05$).

Discussion/Conclusion

Myocardial T2 mapping can detect global edema and differentiate it from normal myocardium. The significant difference in T2 values seen between non-edematous (normal on STIR) myocardial segments in patients and those in healthy volunteer segments, suggests that T2 mapping may actually be more sensitive to regional edema than conventional STIR images. Hence, for detecting myocardial edema in patients with acute myocarditis, T2 mapping is a viable alternative to T2-weighted STIR imaging.

References

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