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Bolus administration T1 mapping as a marker of interstitial myocardial fibrosis in severe aortic stenosis

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Summary

Post-gadolinium bolus T1 mapping was used to assess interstitial myocardial fibrosis in a group of patients with severe aortic stenosis. The changes identified were correlated with regional contractile perfomance as assessed by CSPAMM tagging. T1 mapping proved to be a practical feasible approach for assessing diffuse fibrosis.

Background

Aortic stenosis (AS) is associated with increased interstitial myocardial fibrosis (IMF). This is detectable by cardiovascular magnetic resonance (CMR) after gadolinium infusion. T1-mapping-derived partition coefficients (λ) and extracellular volume fractions (Ve) have also been shown to correlate with IMF after a simple bolus administration of gadolinium. We hypothesized that the λ and Ve would also detect interstitial expansion in severe AS patients compared to healthy controls and that these measures would correlate with abnormal myocardial strain using a high temporal-resolution tagging sequence.

Methods

A Modified Look-Locker Inversion Recovery (MOLLI) sequence was used to generate eleven T1-weighted images. Myocardial and blood pool T1 values were derived by fitting a signal intensity-time curve using CMR42®. The λ was determined by plotting (1/T1myo vs. 1/T1blood pool) at various time points once contrast equilibrium was reached. Ve was derived accounting for the hematocrit. Ventricular long-axis and short-axis T1 maps (basal, mid-ventricular and apical) were acquired using a 1.5T scanner (Siemens) before and 1,2,5,8,15,20,25 and 30 minutes after contrast. Myocardial tagging images were acquired using both single- and multiple-breath-hold Complementary Spatial Modulation of Magnetization (CSPAMM) sequences in multiple planes and analysed with inTag® (Lyon, France).

Results

Subjects with severe AS displayed higher λ and Ve ($p=0.02$). The λ and Ve correlated with indices of reduced myocardial function including reduced strain ($p<0.05$) and increased left atrial dilatation ($p=0.001$). In this presentation, the tips and pitfalls of T1 mapping using MOLLI will be discussed, including detailed discussion of imaging planes, arrhythmia management, breath-hold times, gadolinium administration and artefact reduction.

Conclusions

T1-mapping-derived λ and Ve are significantly elevated in patients with AS compared to healthy controls and correlate well with indices of reduced myocardial performance. This difference was quantifiable after a simple bolus administration of gadolinium. T1-mapping λ and Ve derivation after bolus gadolinium administration is clinically practical and holds promise for the detection of IMF in severe AS.

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