Purpose

Changes in myocardial tissue oxygenation can be detected with blood oxygen level–dependent (BOLD) cardiovascular MRI (CMR) using the magnetic properties of haemoglobin. The objective of this study was to validate whether BOLD-sensitive CMR images can detect an abnormal myocardial tissue response to adenosine infusion in patients with CAD, when compared to fractional flow reserve (FFR).

Methods

Patients undergoing clinically indicated coronary angiography underwent BOLD CMR scans using a clinical 1.5T scanner. Three short axis BOLD cine images were captured during baseline and during adenosine-induced coronary hyperaemia. The mean segmental percent signal intensity (SI) changes were calculated between baseline and hyperaemia in the subendocardial myocardium at basal, mid, and apical regions using the 16- segment model. Segmental ΔSI% in the corresponding coronary territory was defined as ischaemic (using a cut- off of <0.80) or non-ischaemic by FFR.

Results

Twenty-six patients were enrolled in the study (3 were excluded, as they were unable to tolerate CMR) leaving 23 patients (average age 61 ± 9 years) with 262 myocardial segments (baseline and adenosine) subtended by an FFR for analysis. 77 (29%) segments were excluded due to pre-defined criteria for poor image quality, 24 (9%) at baseline and 53 (20%) during adenosine.

Sixty-seven paired myocardial segments subtended by a FFR were compared, 38 segments had FFR values <0.80, 29 had FFRs of ≥ 0.80.

Mean SI change was significantly less in patients with abnormal FFR values (0.23% ± 9.40%), in comparison to patients with normal FFR values (9.37% ± 10.07%; p=0.0003) when comparing all segments.

There was also a significance difference when the average of all segments subtended by a single FFR were compared (0.73% ± 5.34% vs. 10.53% ± 8.25%; p=0.02).

Conclusion

A blunted hyperemic response to adenosine detected with BOLD-sensitive CMR using a 1.5T scanner can identify functionally significant coronary artery stenosis. However, image quality remains a limitation of the approach. Most excluded segments were from early studies, suggesting improved acquisition quality with experience.

No Conflicts of interest to Disclose