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Feasibility of non-contrast cardiac MR stress T1-mapping to assess coronary artery disease in patients on haemodialysis

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Introduction

Patients with end-stage renal disease (ESRD) are at significantly elevated risk of cardiovascular disease and have a high prevalence of coronary artery disease (CAD). Identification of CAD in this population is challenging and the most appropriate screening modality is the subject of much debate. Adenosine stress cardiac MRI (CMR) derived (non-contrast) native T1 mapping has been proposed as a method to assess myocardial blood flow changes before and after vasodilatory stress. This technique has been shown to accurately detect CAD in the general population, identifying areas of ischaemia or microvascular dysfunction, but has never been tested in an ESRD population. This feasibility study assessed the potential utility of non-contrast stress native T1 mapping for identifying myocardial ischaemia in patients on haemodialysis.

Methods

58 patients underwent adenosine stress CMR scans. 10 patients undertook identical reproducibility scans within 2 weeks of the first scan. Change in native T1 (ΔT1) in response to stress were calculated as previously described ([stress T1−rest T1]/rest T1×100). Inter-study reproducibility of adenosine stress and rest myocardial native T1 mapping were assessed using the coefficient of variability (CoV) and Bland-Altman plots for test-retest scans. Correlations between T1 and clinical variables, left ventricular (LV) structural and functional measures were examined. Differences in ΔT1 between subjects with a history of CAD or previous renal transplant were assessed with unpaired T-tests.

Results

46 subjects were male and 12 female. Mean age was 55 years (range 20-78). Median dialysis vintage was 19.5 months (IQR=8.0-52.3). Thirteen patients had a previous kidney transplant (22%) and fifteen had previous history of CAD (26%). Inter-study reproducibility for rest and stress myocardial native T1 times was excellent (CoV rest=1.2%; CoV stress=1.5%) with no evidence of systematic bias on Bland-Altman analyses (Figure 1 and 2). Of the 58 participants who underwent stress CMR, only 1 did not have an adequate response to adenosine. All patients tolerated and completed the scan, with no adverse effects. Mean native T1 rest, stress and ΔT1 were 1259±59ms, 1296±52ms and 3.0±3.1%, respectively. Mean ΔT1 was significantly lower in patients with a history of ischaemic heart disease (1.4% vs 3.5%; p=0.034) and significantly higher in patients who received a kidney transplant (5.0% vs 2.4%; p=0.008). Increasing age was significantly associated with lower ΔT1 (r= -0.346; p=0.014) and higher native T1 rest (r= 0.401; p=0.004) values. Myocardial native T1 times correlated with systolic blood pressure (rest: r = 0.461, p=0.005; stress: 0.391, p=0.02) and LV mass/LV end-diastolic volume (stress: r= -0.365, p=0.009).

Discussion

This is the first time this technique has been evaluated in patients with ESRD. The technique was well tolerated and highly reproducible. ΔT1 was lower in older patients with a history of ischaemic heart disease inferring the presence of occult CAD. Transplanted patients had a higher ΔT1 suggesting a degree of

cardioprotection and preserved coronary artery and microvascular function compared to patients who have never been transplanted. These preliminary data warrant further exploration in prospective studies in patients with ESRD with direct comparison to coronary angiography and other non-invasive measures of CAD.