Use of quantitative myocardial perfusion mapping by CMR for characterisation of ischaemia in patients post coronary artery bypass graft surgery

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Background: Quantitative myocardial perfusion mapping using Cardiac Magnetic Resonance (CMR) imaging is used for evaluation of ischaemia in the context of native vessel coronary disease, but its diagnostic performance in patients with grafts is not well established. Perfusion defects are often detected in these patients, but whether these are a consequence of a technical limitation (delayed contrast arrival from graft conduits) or a true reflection of reduced myocardial blood flow is unclear.

Methods: 39 patients undergoing stress perfusion CMR with previous coronary artery bypass graft (CABG) surgery, unobstructed left internal mammary artery (LIMA) grafts to the left anterior descending (LAD) artery on coronary angiography and no CMR evidence of prior LAD infarction were included. Myocardial blood flow (MBF) and myocardial perfusion reserve (MPR) were evaluated with quantitative perfusion mapping and the factors determining MBF in the LIMA-LAD territory (AHA segments 1,2,7,8,13,14), including the impact of delayed contrast arrival through the LIMA graft were evaluated.

Results: In 28 out of 39 cases a myocardial perfusion defect was reported on visual assessment in LIMA-LAD myocardial territory, despite the presence of unobstructed LIMA graft and no LAD infarction. Chronic total occlusion (CTO) of the native LAD was an independent predictor of stress MBF (B=-0.36, p =0.027) and the strongest predictor of MPR (B=-0.55, p 0.005) within the LIMA-LAD myocardial territory after adjusting for age, left ventricular (LV) ejection fraction, and presence of diabetes. CTO of the native LAD was associated with a reduction in stress MBF in the basal myocardial segments (-0.57ml/g/min, p = 0.002) but had no effect on the MBF of apical segments (-0.31ml/g/min, p = 0.084). Increasing the maximum value for allowable arterial delay (TA) of contrast in the quantitative mapping algorithm resulted in a small increase in myocardial blood flow in the LIMA-LAD territory both at stress (0.07 ± 0.08ml/g/min, p < 0.001) and rest (0.06 ± 0.05ml/g/min, p < 0.001).

Conclusions: Perfusion defects detected in LIMA-LAD subtended territories are common despite graft patency. These defects are likely to represent genuine reduction in MBF, resulting from native LAD coronary occlusion. Prolonged contrast transit time associated with LIMA grafts results in small underestimation of MBF as measured by quantitative CMR perfusion mapping, but does not account for the degree of MBF reduction seen in these patients.

Figure 1. Study patient with unobstructed LIMA to LAD graft and evidence of inducible perfusion defect in LIMA-LAD territories. (A): First pass perfusion CMR imaging. (B): Perfusion mapping showing reduced stress MBF in mid antero-septum (0.85ml/g/min) compared to the apical septum (1.65ml/g/min). (C): Late gadolinium enhancement showing no evidence of previous infarction. (D,E): Coronary angiography demonstrating unobstructed LIMA graft (D) and anastomosis site (E).

Abstract Figure 1.