MRI PERFUSION INDICES DURING THE EVOLUTION OF MICROEMBOLIZED MYOCARDIAL INFARCT

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Hypothesis: Understanding the burden of different pathologies of coronary artery disease in patients is of critical importance. In acute myocardial infarction mechanical revascularization (PCI or bypass grafting) cause additional necrosis reflected by increase in cardiac injury biomarkers [1], because embolization of intracoronary thrombus or atherosclerosis due to particulate debris are not preventable, despite current anticoagulant and antiplatelet adjunctive therapy, aspiration or protection devices. Following PCI, MRI demonstrated new areas of necrosis and a decline in myocardial perfusion at 24hrs[1]. Such procedure induced thrombosis and later inflammation surrounding islets of myocardial necrosis[2]. The aims of this study were to chronologically (3 days and 5 weeks) monitor and compare myocardial perfusion and viability in swine subjected to myocardial infarction with and without coronary microembolization.

Methods: Under X-ray guidance, a 3F balloon catheter was placed selectively beyond 2nd diagonal branch of the LAD coronary artery to occlude the artery for 90min in 16 pigs and in 8/16 microemboli (32mm^3 volume and 40-120µm diameter) was delivered prior to reperfusion. Three days and 5 weeks after coronary interventions, first pass MR perfusion (1.5T) was performed using 0.1 mmol/kg Gd-DTPA injected as a bolus (3ml/s) using power injector. The saturation-recovery gradient echo pulse sequence parameters were: TR/TE/flip angle=4.5ms/2.2ms/20°. Short-axis slices at 22 and 28mm levels from apex within the infarct were used. Max upslope, max signal intensity and time to the peak were determined in remote, acutely infarcted myocardium and scar tissue. An inversion recovery gradient echo pulse sequence (TR/TE/flip angle=5ms/2ms/15°) was used to measure infarct size at 3 days and 5 weeks after coronary interventions.

Results: Quantitative analysis of MR perfusion indices are shown in Table 1. At 3 days after interventions, all animals subjected to LAD occlusion/reperfusion showed significant decline in regional myocardial perfusion compared with remote myocardium. However, the decline in perfusion was greater in infarct with microemboli compared with infarct without microemboli. The perfusion of infarcted myocardium without microemboli did not change over the course of 5 weeks, but deteriorated in infarct with microemboli as well as remote myocardium in both groups (Fig. 1 and Table 1). At 5 weeks, hypertrophy was evident in remote myocardium of both groups. DE-MRI infarct size was 12.4±0.8% and 14.5±0.5% (*P*=0.04) in infarct without and with microemboli, respectively.

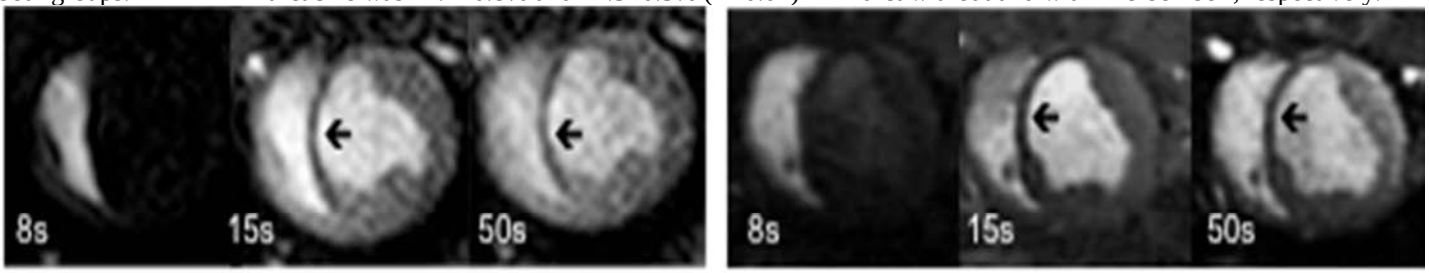

Fig. 1: Representation of regional perfusion at 5 week in infarct without (left) and with microemboli (right).

Table: 1.	Max upslope (s^{-1})	Max signal (au)	Time to peak (s)
LAD occlusion/reperfusion without microemboli (n=8)			
Remote myocardium			
3 days	304±25	1413±72	10±1
5 weeks	376±42	1533±81	12±1
Infarct			
3 days	187±21*	1061±68*	18±2*
5 weeks	161±22*	1058±58*	15±1*
LAD occlusion/reperfusion with microemboli (n=8)			
Remote myocardium			
3 days	139±17	1395±90	13±1
5 weeks	132±24	1127±57*+	12±1
Infarct			
3 days	65±7*	795±71*	19±1*
5 weeks	38±6*+	690±34*+	23±1*+

*P<0.05 compared with remote myocardium of corresponding group time point and + P<0.05 5 weeks compared with 3 days.

Conclusion: MR indices of myocardial perfusion are valuable for assessing the effects of coronary microemboli in pre-existing AMI, scar infarct and hypertrophied remote myocardium associated with infarct evolution. The high sensitivity of MRI in assessing myocardial perfusion makes it a powerful tool for evaluating of coronary interventions and efficacy of new distal filtration devices[3].

References: 1) Selvanayagam JB, Cheng AS, Jerosch-Herold M, et al. Circulation. 2007;116:1458-64. 2) Herrman J. Eur Heart J. 2005; 26:2493–2519. 3) Stone, GW, Abizaid A, Silber S. et al. JACC 2012; 60(19):1975-84.