CARDIAC PERFUSION MRI AT 3T FOR THE ASSESSMENT OF ENDOTHELIAL DYSFUNCTION IN DIABETIC PATIENTS

A. Tognolini[1], W. Marfori[1], C. Arellano[1], G. Heidari[1], C. Darwin[2], Y. Natsuaki[1,3], G. Laub[1,3], M. Krishnam[4], and S. Ruehm[1]
[1]Diagnostic Cardiovascular Imaging, UCLA, Los Angeles, CA, United States, [2]Medicine, Endocrinology, UCLA, Los Angeles, CA, United States, [3]Siemens Medical Solution, Los Angeles, CA, United States, [4]Cardiovascular and Thoracic Imaging, UCI, Irvine, CA, United States

Background and Objective Cardiovascular risk factors such as diabetes, metabolic syndrome and smoking can disrupt the integrity of the endothelium leading to endothelial dysfunction (ED) which manifests as altered production of Nitric Oxide (NO) and therefore impaired arterial vasodilatation in response to an appropriate stimulus. Endothelial dysfunction is a known precursor of atherosclerosis. Cold pressor test (CPT) allows the evaluation of endothelium dependent coronary ***vasomotor function***, induced by a nociceptive stimulus. In normal coronary arteries, CPT stimulates nitric oxide (NO) release from the endothelium resulting in vasodilation and increased myocardial blood flow while in the presence of endothelial dysfunction; NO release and therefore coronary dilation are reduced or may even be paradoxically constricted. Objective of this study is to assess the role of cardiac perfusion MRI as a potential imaging biomarker for endothelial dysfunction.

Method Twenty consecutive subjects, 10 patients with known DM (8 men and 2 women) and median age of 50.5 years old (range: 19-58) and 10 age/sex matched healthy volunteers were enrolled in this IRB approved, HIPAA compliant prospective study. Patients with known or suspected coronary artery disease were excluded from the study. Three LV short axis were acquired on a 3.0T MRI scanner (Trio, Siemens Healthcare, Erlangen, Germany) with dynamic turbo flash sequence (IPR#578:CV_EPI_DS_AIF. Parameters: TR:2msec,TE:0.9msec,TI:85msec, FA:10°,slice thickness:8mm, scan time/slice:145msec,matrix size:192x124, GRAPPA acceleration factor 2) after the injection of 5cc (5cc/sec) of Gd-based contrast agent (Multihance, Bracco, Milan, Italy) followed by a 20 ml saline flush at baseline and post-CPT (immersion of the foot in ice water). Blood pressure and heart rate were monitored before and after each acquisition and no serious adverse reaction was recorded. Automatically reconstructed (non-rigid registration, surface coil correction, spatial and temporal denoising and motion correction) short axes images as well as the automatically generated semi-quantitative parameter color maps (*figure 1a*) were generated and myocardial perfusion was assessed by utilizing a commercial post-processing software (Argus, Siemens).
For each of the 3 short axis, a global Signal slope (SI/s) value (linear fit of the SI(t) curve- *figure 1b,c*) was calculated by average over the obtained 6 myocardial segments (AHA classification). The Signal slope obtained for each slice was then averaged and the global perfusion changes after CPT were recorded and analyzed for statistical significance. Values are presented as average with standard error of mean.

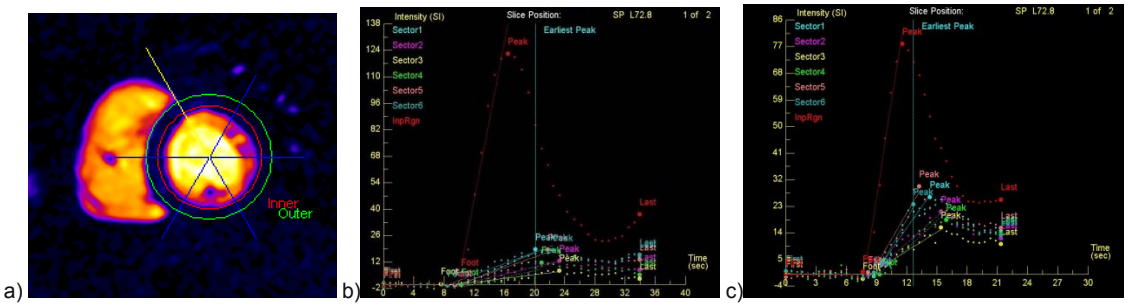

Fig. 1 a-c: The automatically generated Slope perfusion map (a) shows no focal myocardial perfusion defects. Figure b) and c) displays the calculated time/intensity curves changes for each myocardial segment at rest (b) and significantly increased myocardial perfusion post-CPT in a healthy volunteer.

Results None of the enrolled subjects showed focal perfusion defects. The SI slope (SI/sec) changes are summarized in *Fig. 2*. Patients with Diabetes showed stable or even decreased myocardial perfusion after cold pressure stimulation, reflecting impaired vasomotion/endothelial function, whereas healthy volunteers showed on average a two-fold increase of perfusion (p=0.0009).

Conclusion These preliminary results hold promise that cardiac perfusion MRI in combination with cold pressure testing may be used for the diagnosis of endothelial dysfunction and may therefore serve as an early imaging biomarker for increased risk of atherosclerosis.

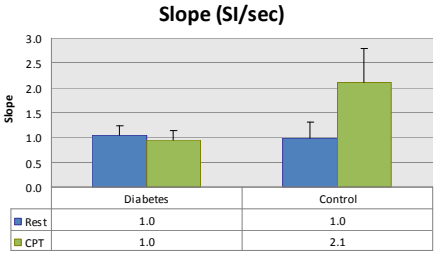

Fig. 2: Slope (SI/sec) changes post-CPT in patients with DM vs. control group.