

Flow Mediated Vasodilatation Induced Brachial Artery Area Change versus Atherosclerotic Risk Factors

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INTRODUCTION

Endothelial dysfunction is an early event in the development of atherosclerosis, and is also seen in hypertension, diabetes and heart failure. Echo imaging of the brachial artery (BA) has been used to evaluate endothelium-dependent flow-mediated vasodilatation (FMD). It has been shown that MRI can evaluate BA reactivity to hyperemia more reproducibly (*) than echo due to its ability to image at high spatial resolution at any arbitrary plane. We hypothesize that the FMD %brachial area change evaluated using MRI correlates with atherosclerotic risk factors.

MATERIAL AND METHODS

Patients with and without hypertension, hyperlipidemia, smoking and family history of premature coronary disease had screening calcium score and CT coronary angiogram to exclude calcium scores > 400 or evidence of epicardial coronary stenosis $\geq 50\%$. A total of 23 nondiabetic subjects were enrolled with IRB approval and divided into a normal group (NI) without any risk factors, n=6, ages: 40 to 49 (Mean and SD: 45.2 \pm 3.8) and a risk group (RISK), n=17, ages: 38 to 66 (Mean and SD: 51.1 \pm 6.7) with risk factors including: hypertension (n=4), hyperlipidemia (n=13), smoking (n=3), and family history of premature coronary artery disease (n=4). Prior to participation, volunteers were asked to fast for at least 8 hours, avoid exercise, caffeine, smoking and high fat foods for 6 hours and withhold any vasoactive medications. The study was performed on a 1.5 T Siemens scanner (Siemens Medical Solutions, Malvern, PA) with a four-element phase array coil (Machnet BV, Eelde, the Netherlands) using an ECG Triggered TrueFISP technique. To ensure accurate imaging of the BA, double oblique long axis BA images were first collected and cross sectional BA images were prescribed perpendicular to the long axis of the BA. Sequence parameters were as follows: TR/TE/FA = 2.9ms/1ms/65°, data matrix 256 \times 384, field-of-view 80 \times 110cm², number of segments 7, bandwidth per pixel 200Hz and voxel spatial resolution of 0.3 \times 0.3 \times 3mm³, an acquisition window of 250ms in diastole. Total imaging time for one measurement was about 15 seconds. After baseline BA imaging, a blood pressure cuff on subject's forearm was inflated to 50mm of Hg above the systolic blood pressure for 5 minutes and then was rapidly deflated. Thirty seconds prior to cuff deflation, serial imaging of the BA was begun and continued for three minutes thereafter. BA area change was evaluated as the % difference between the baseline BA area and maximal BA area after blood pressure cuff deflation. An unpaired student t test was used in comparing %BA area change between groups with different risk factors. Custom region growing software in Matlab was used to search neighboring pixels with similar signal intensity starting from a user defined starting seed point and propagated through images in the time series.

RESULTS

An example of BA (arrows) image is shown in **Figure**, baseline BA on the left and BA at 1 minute after blood pressure cuff deflation on the right. The mean and SD of % BA area change measured were 16.3 \pm 3.4 for normal (NI, n =6) and 11.8 \pm 3.6 for patient with cardiac risk factors (RISK, n=17), respectively, two tailed p = 0.01. Results are summarized in **Table**.

CONCLUSION

Brachial artery flow mediated vasodilatation can be evaluated using an ECG triggered segmented TrueFISP technique. Subjects with risk factors exhibit reduced FMD BA area change compared to normals. This simple rapid noninvasive test might be useful for early detection of atherosclerosis and assessment of therapeutic interventions that seek to reverse risk factor effects.

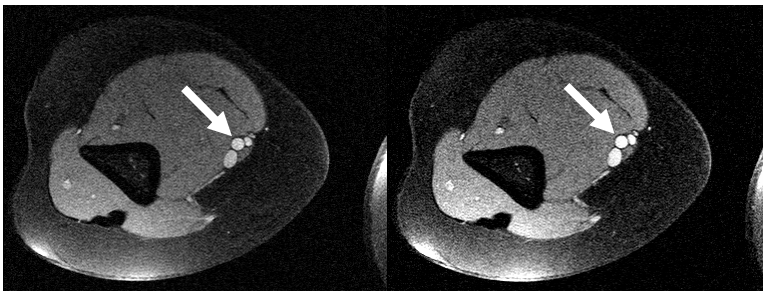


Figure An example of BA (shown at arrow) measurement: baseline BA on the left and dilated BA at 1 minute after blood pressure cuff deflation

Table FMD Brachial Artery % Area Change among Subjects with or without Atherosclerotic Risk Factors

Classification	n	Mean \pm SD	P <
Risk Factor +	17	11.8 \pm 3.6	0.01
Risk Factor -	6	16.3 \pm 3.4	

* Sorensen MB, et al., Long-Term Use Of Contraceptive Depot Medroxyprogesterone Acetate In Young Women Impairs Arterial Endothelial Function Assessed By Cardiovascular Magnetic Resonance, *Circulation*. 2002; 106 1646-1651.