Non-Contrast MRA of Pedal Arteries in Type II Diabetes: Effect of Disease Load on Vessel Visibility

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Introduction: Arteries below-the-knee are typically involved in type II diabetes [1]. The utility of non-contrast MR Angiography (NC-MRA) [2] in determining the severity of the diseased arteries remains challenging as the local blood flow may be impaired by local and systemic load of the disease. The purpose of this study was to investigate the effect of the disease indicators on the image quality of a novel NC-MRA technique: flow sensitive dephasing prepared steady state free precession (FSD-SSFP) [3].

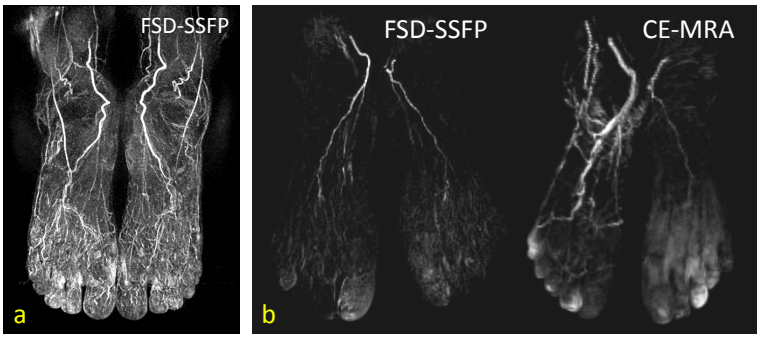
Methods: ECG gated FSD-SSFP sequence were performed on a 1.5 T MR system with 12-channel head coil to image bilateral feet prior to the routine Gd-DTPA contrast enhanced MRA (CE-MRA) as a reference in 39 subjects diagnosed with type II diabetes and qualified to be imaged with CE-MRA. Typical imaging parameters were controlled as published [3]. The first order gradient moment (m1) was chosen to optimize flow suppression for each subject. Two experienced Radiologists ranked the overall visibility of 5 pedal arteries segments (VA) and the contamination from soft tissue (SC) and veins (VC) on the MIP MRA images, in which 1 was denoted as excellent VA with minimal or no SC or VC; 2 as suboptimal VA with mild SC or VC; 3 as fair VA with moderate SC or VC; and 4 as poor VA, severe SC or VC. Consensus score was recorded as image quality indicator in 39 consecutive subjects (29 men, 16 women, mean age, 57.9±11.4 years). Chronic complications, body mass index and lab test measures of random blood glucose (RBG), lipid panel and glycated hemoglobin (HbA1c) prior to the MRA exams were recorded as disease indicators. Spearman's rank correlation (Spearman's rho), Cochran-Armitage trend test and Ordinal regression were performed to investigate the correlation and trend between disease indicators and image quality.

Results: Image quality of 35 (89.7%) NC-MRA and 37 (94.8%) of CE-MRA were scored 1 to 3 and were recognized to be adequate for vessel assessment. Abnormal RBG (86.7%), diabetic foot (DF) (30.8%) and diabetic nephropathy (Dnephro) (56.4%) were significantly correlated with the overall VA, VC and SC for NC-MRA (Table) (Figure a). Effect of DF on Image quality manifested a significant linear trend for both CE- and NC-MRA ($P<0.05$ and 0.01, respectively). RBG level was significantly correlated with the overall VA in NC-MRA without substantially affecting VC or SC ($p<0.05$) (Figure b). Image quality was found independent of hypertension, coronary artery disease, abnormal lipid panel (90.9%), HbA1c (75.0%) or optimized m1 value in this study.

Conclusion: FSD-SSFP proved to be a useful alternative imaging modality for pedal artery screening in diabetic patients. Its utility could be complicated irrespective of technical optimization with the presence of diabetic foot, nephropathy and abnormal RBG level. Properly choosing candidate for FSD-SSFP would augment the application potential of this technique in diabetic patient care with the benefit of avoiding contrast induced nephropathy.

Table. Correlation Coefficient betweeen disease indicators and image quality (* Spearman rho correlation; △Cochran-Armitage Trend Test. *,△ $P<0.05$; **,△△ $P<0.01$).

	MRA	RBG	DF	Dnephro	HbA1c
VA	NC	0.42*	0.39*△	0.37*	–
	CE	–	–	–	–
VC	NC	–	0.39*△	–	–
	CE	0.44*	0.62**△△	–	–
SC	NC	–	0.35*△	0.37*	–
	CE	–	–	–	–



Figures. a. Representative 3D FSD-SSFP images with significant SC and VC in subject with DF. b. The overall VA was impaired without severe SC and VC for both NC- and CE-MRA in a representative subject with high RBG.

References:

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