Time Resolved Peripheral MRA: Correlation With Functional Lower Limb Impairment.

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Introduction: Atherosclerosis is one of the leading causes of morbidity and mortality in the Western world at present. Peripheral arterial disease (PAD) has a prevalence of 11.4% to 33.8% in those over 60 years of age,[1] and is associated with a relative risk of 3.1 for all-cause mortality and relative risk of 6.6 for coronary artery disease associated mortality.[2] Within this population, 6–10% will have symptoms of intermittent claudication, and of these, 10–20% may develop severe limb-threatening ischemia, requiring endovascular or surgical revascularization or even subsequent amputation.[3] PAD severity, as assessed by ankle brachial index (ABI), significantly correlates with the degree of functional impairment.[4] However, a correlation between the severity of PAD, as determined by time resolved magnetic resonance angiography (MRA), and functional limb impairment has not been determined.

Purpose: The aim of this study is to determine if atherosclerotic lesion severity, determined by time resolved MRA, can predict the degree of lower limb functional impairment in patients with peripheral arterial disease.

Methods: 58 patients with known peripheral arterial disease (PAD) were prospectively recruited over a six month period. Demographics, cardiovascular risk factors, clinical lower limb symptoms and a number of functional parameters, including ankle brachial index (ABI), six-minute walking test, four meter walking velocity (usual speed), four meter walking velocity (fast speed), Short Form 12 (SF-12) physical functioning score, Walking Impairment Questionnaire (WIQ) distance, speed, and stair climbing score were recorded. Time resolved MRA was performed using an echo sharing TWIST sequence on a 1.5T Siemens Espree MRI scanner. A single dose of Magnevist (gadopentetate dimeglumine, Berlex, Montville, NJ, USA) was administered intravenously. Angiography images from one station, the groin to the knee, were acquired. Images were reviewed and lesions were classified according to TASC II Classification,[5] collateral vessels were counted and graded, arterio-venous transit time (AVTT) was calculated. The relationship between arterial lesion severity, collateral vessel formation, arterio-venous transit times and lower limb functional impairment were determined.

Results: 116 lower limbs were evaluated with time resolved TWIST MRA, 12%(n=14) with TASC D lesions, 29%(n=34) with grade 3-4 collaterals, mean AVTT of 50.7 seconds. When the study population was divided based on TASC lesion severity (TASC 0,A versus TASC B,C,D), there is a significant difference in the ABI (least square mean 0.859 versus 0.643 respectively, $p<0.0001$), WIQ distance score (least square mean 73.0 versus 46.6 respectively, $p=0.0135$) and WIQ speed score (least square mean 60.3 versus 40.6 respectively, $p=0.0163$), with a trend towards significance for the six-minute walking score (least square mean 1420.7 versus 1184.6 respectively, $p=0.0632$). When the patients were divided based on collateral grade (grade 0,1,2 versus grade 3,4) there is a significant difference in the ABI (least square mean 0.839 versus 0.580 respectively, $p<0.0001$), with a trend towards significance for the WIQ climbing score (least square mean 46.7 versus 63.7 respectively, $p=0.0707$).

Conclusion: Time resolved peripheral magnetic resonance angiographic lesion severity and collateral grade significantly correlates with lower limb functional impairment in patients with PAD. This non-invasive imaging technique can now potentially be reliably employed for peripheral arterial disease severity stratification.

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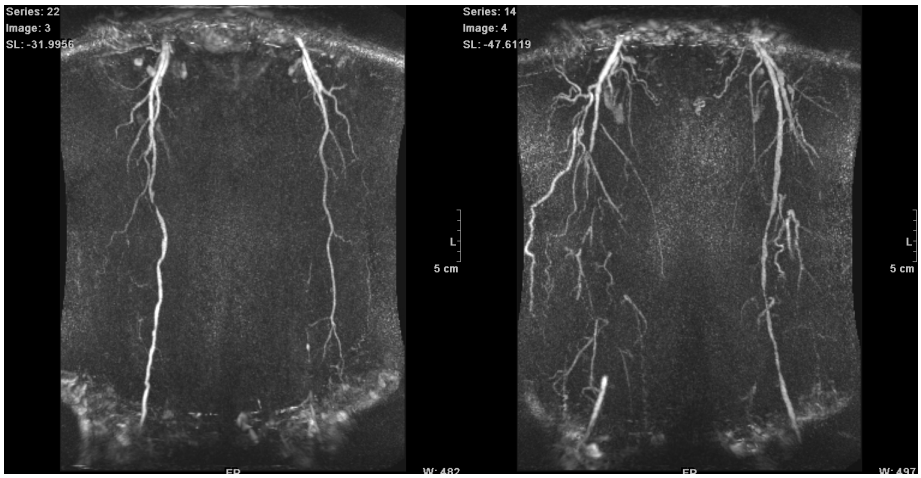

Figure 1: Selected maximum intensity projection (MIP) images from two patients with PAD. MRA on left demonstrates a left TASC D lesion with large collateral from profunda femoris. MRA MIP on the right shows a right TASC D lesion with numerous collaterals, grade 3.