Feasibility of Simultaneous Non-contrast Angiography and IntraPlaque hemorrhage (SNAP) in Femoral Artery Imaging

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Introduction: Peripheral arterial disease (PAD) is a common and ‘silent’ disorder that usually affects 3% to 7% of people in the general population¹. Femoral artery is a major target vascular bed of PAD [², ³]. As the progression of femoral artery atherosclerosis, individuals present intermittent claudication due to the arterial luminal narrowing and ischemia in the legs. Intraplaque hemorrhage is an important high-risk features in atherosclerotic plaque, and have high prevalence in femoral plaques⁴,⁵. In addition, a number of studies demonstrated that PAD is significantly associated with an increased risk of heart attack and stroke [², ³]. Thus, early identification of PAD by non-invasive imaging techniques will be helpful for prevention of cardiovascular events. Recently, a simultaneous non-contrast angiography and intraplaque hemorrhage (SNAP) sequence [⁶] was proposed for carotid artery imaging, which allows identification of intramural hematoma/thrombus and measure of luminal stenosis simultaneously. However, the feasibility of SNAP imaging in assessment of femoral artery disease has not been studies. In this study, we sought to determine the feasibility of SNAP techniques in femoral artery imaging.

Methods: Six healthy volunteers (4 male, mean age 23.7 years) and two patients (male, mean age 56.5 years) were recruited in this study. After informed consent, each subject was scanned using a 3.0T whole-body MR scanner (Achieva TX, Philips Medical System, Best, the Netherlands) with a 32-channel phase array cardiac coil. To account for the slow flow of femoral artery, the SNAP sequence is optimized. 3D SNAP images were acquired coronally with the following optimized imaging parameters: TR/TE 12/4.5ms, FA: 5°/5°, IRTR 3182ms, FOV 300×350×90mm³, resolution 1.6×1.6×1.6 mm³, interpolated to 0.8×0.8×0.8 mm³, NSA: 1, inversion pulse delay time: 792ms (Fig.2). In SNAP sequence, only the signal of blood is negative⁴. So the MR angiography can be generated from SNAP images by setting positive values to zero and inverting the negative blood signal. On the other hand, intramural hematoma/thrombus can be shown in SNAP with bright positive signal [⁴]. For comparison, a 3D MERGE sequence [⁷] was scanned with parameters: .

Results: The femoral arteries were successfully imaged using SNAP sequences in all cases. A typical images were shown in Fig. 1. The fourth-grade small branches of femoral artery were depicted clearly. The luminal and vessel wall boundaries were well delineated (Fig.1). When applied to patients with femoral plaque, SNAP sequence is able to yield clear image of plaque which is consistent with 3D MERGE (Fig.3a, b), and MRA image to identify the luminal stenosis (Fig.3c). Notably, the bright signal of SNAP image inside vessel wall (arrow in Fig. 3b) indicated the presents of intraplaque hemorrhage or mural thrombus.

Discussion and conclusion: In this study, the feasibility of SNAP sequence was successfully validated for femoral artery imaging in healthy volunteers and patients. The luminal boundaries of femoral arteries were well delineated on SNAP images that allow measure of luminal stenosis non-invasively. Meanwhile, SNAP vessel wall images provide the opportunities for detection of high-risk features (intraplaque hemorrhage) within femoral vessel wall or mural thrombus. Future studies are suggested to investigate the value of SNAP imaging techniques in characterization of PAD in larger population.

References: