Comprehensive diabetes imaging with whole body MRI

S. Wagner[1], S. O. Schönberg[1], H. Kramer[1], J. Rieger[1], S. Kessler[2], M. F. Reiser[1]

[1]Department of Clinical Radiology, Ludwig-Maximilians-University Hospital, Munich, Germany, [2]Department of Surgery - Innenstadt, Ludwig-Maximilians-University Hospital, Munich, Germany

Introduction:

Diabetes is one of the major causes for morbidity and mortality in the world. The worldwide prevalence of diabetes is 5.1% with the highest rate of prevalence found in North America (7.9%) and Europe (7.8%), and the number of people with diabetes is even expected to increase in the coming decades [1]. Due to the combination of systemic manifestations such as diffuse micro- and macroangiopathy and silent myocardial infarction as well as local disease such as osteomyelitis or Charcot´s foot, diabetes offers great diagnostic challenges to radiologists. By using new hard- and software design, especially parallel acquisition techniques, multichannel receiver coils and new sequences such as phase-sensitive inversion recovery, it has recently become possible to acquire high quality MR images with an excellent spatial resolution within a short time. So far, these techniques have only been used for cardiovascular screening as well as for screening of malignant disease [2, 3]. In the literature no studies on disease specific imaging with whole body MRI can be found. Therefore the purpose of this study was to implement and evaluate a MR protocol for comprehensive diabetes imaging.

Materials and Methods:

We examined 10 asymptomatic patients with type 2 diabetes mellitus aged between 50 and 75 (mean = 65.5) years. MR imaging was performed on a 1.5T whole body MR system (Magnetom Avanto, Siemens Medical Solutions, Erlangen, Germany) equipped with 32 receiver channels. IPAT (integrated parallel acquisition techniques) and a GRAPPA (generalized autocalibrating partially parallel acquisitions) reconstruction algorithm were used with acceleration factors between 2 and 3. To assess typical diabetic complications, cardiac, vascular and high-resolution foot imaging was performed. Cardiac function was assessed with a single breath-hold multi-slice real time trueFISP technique with an iPAT factor of 2. For delayed contrast enhancement (DCE) imaging, a phase sensitive inversion recovery (PSIR) technique was performed 15 after administration of contrast media within a single breathhold [4]. High spatial resolution 3D-Gd-MR-Angiography of the carotids (resolution 0.9 x 1.7 x 1.3), the abdominal aorta (resolution 1.6 x 0.8 x 1.5) , the thigh (1.4 x 1.0 x 1.5), calf (resolution 1.3 x 0.9 x 1.3) and pedal arteries (resolution 1.2 x 1.0 x 0.9) was obtained with an iPAT acceleration factor of 3. Finally, high spatial resolution native and contrast-enhanced images of the feet were acquired.

Results and Discussion:

In 10 patients multiple vascular pathologies such as moderate carotid artery stenosis, severe atherosclerosis of the abdominal aorta and occlusion of peripheral arteries were found. In one asymptomatic patient a silent myocardial infarction was detected by positive late enhancement. Hypervascularization in the foot seemed to correlate with non-inflammatory disease which may represent Charcot´s foot rather than osteomyelitis [5].

a) b)

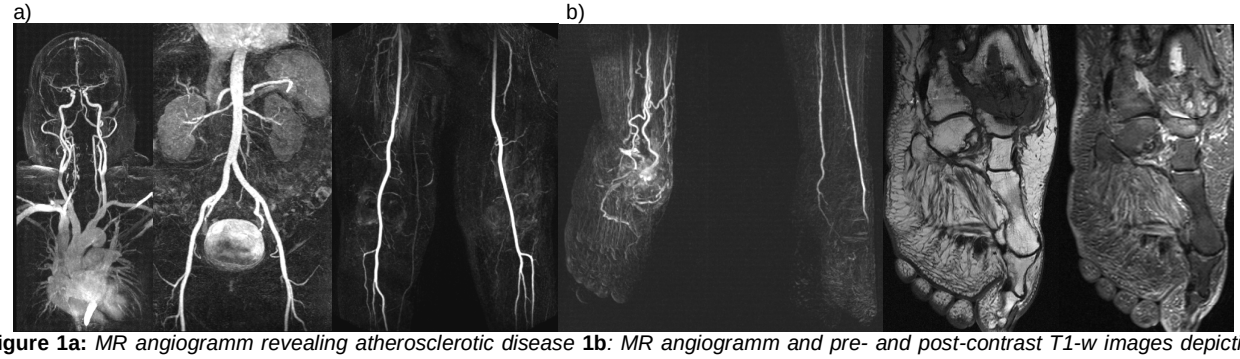
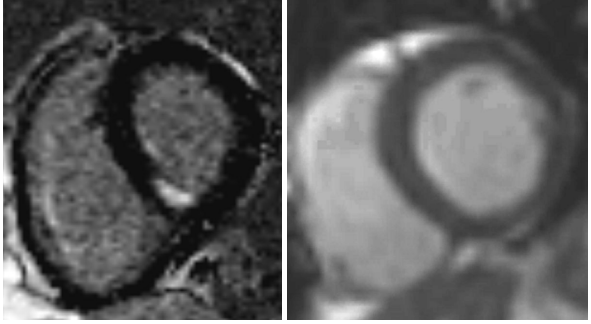


Figure 1a: *MR angiogramm revealing atherosclerotic disease* **1b***: MR angiogramm and pre- and post-contrast T1-w images depicting Charcot´s foot with hypervascularization*

Conclusion:

High image quality is especially necessary for diseases offering diagnostic challenges. Diabetes as a metabolic disorder that shows local and systemic manifestations is one of these diseases that need accurate disease management and sophisticated workup. Due to the integration of technical advances such as iPAT, multichannel MRI and PSIR sequences for phase sensitive late enhancement, whole body MRI is a highly promising method for comprehensive disease specific imaging. Typical pathologies in diabetics can be identified and patients can be treated early. Contrast enhanced MR-angiographic images of the feet might be helpful in differentiating Charcot´s foot from osteomyelitis on the basis of neo-vascularization [5].

a) b)



References:

[1] International Diabetes Federation, www.idf.org
[2] Kramer H et al., Radiology 2005 (in press)
[3] Schmidt GP, Radiologe 2004; 44:889-898
[4] Huber A, et al., Radiology 2005 (in press)
[5] Tello R. et al., MR Angio Club 2004, London, Ontario (CAN), Book of Abstracts, p. 91
[6] Wintersperger B.J. et al., Eur Radiol 2003, 13 (8):1931-6

Figure 2a) *DCE and* **b)***Function (one representative time-resolved slice from multislice single breath-hold images (acceleration factor of 2) showing an inferior wall infarct*