

# Comprehensive imaging with whole body MRI at 1.5 and 3.0 Tesla in patients with longstanding diabetes

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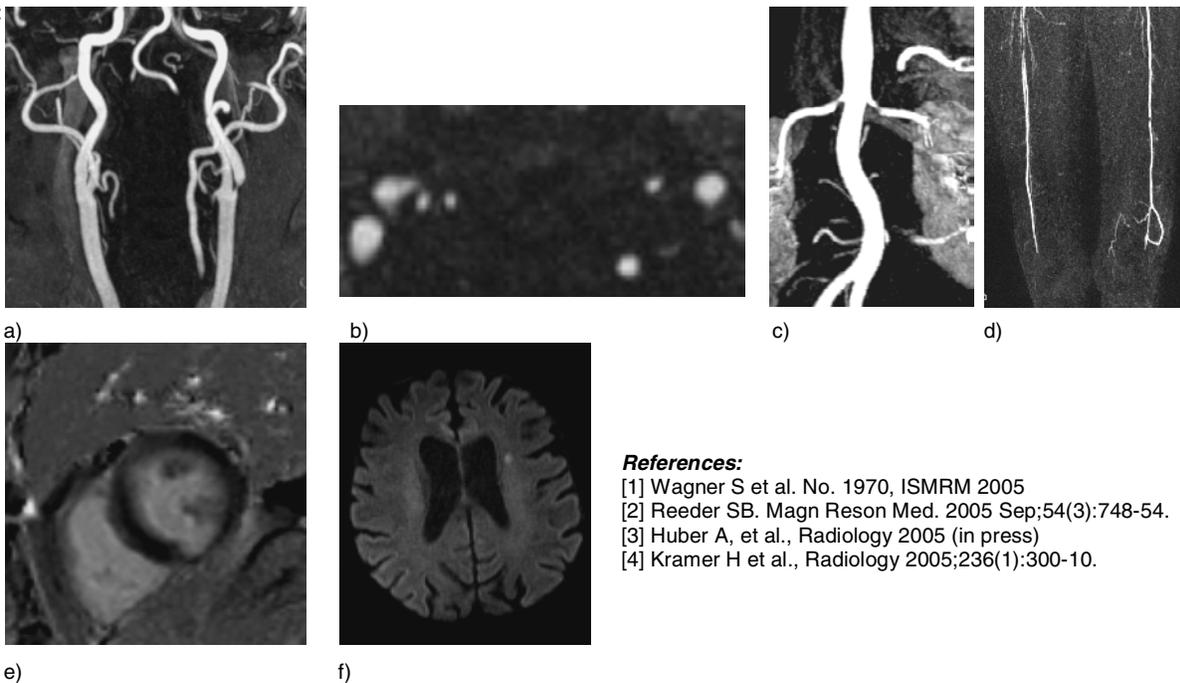
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**Introduction** - Recently introduced dedicated whole-body MRI protocols allow for comprehensive assessment of complications from macro- and microangiopathy in long standing diabetes [1]. At 1.5 Tesla the multi-organ assessment still imposes limitations in spatial and temporal resolution compared to single-organ studies. The purpose of this study was to implement a high-resolution protocol on a 3 T whole body scanner and evaluate the protocol in asymptomatic patients suffering from diabetes for more than ten years.

**Materials and Methods** - 45 asymptomatic patients with type 1- or 2-diabetes lasting for more than ten years (mean age 57 years) were examined on a 1.5 T (12 pts) or 3.0 T (33 pts.) whole body MR system (Magnetom Avanto/Magnetom Trio, Siemens Medical Solutions), both equipped with 32 receiver channels. Imaging of the brain with axial T2-w-images, T2\*- images, diffusion weighted images and a FLAIR-sequence was performed. For the time-of-flight-MR angiogram of the cerebral arteries a spatial resolution of 0.7 x 0.5 x 0.7 mm was acquired. At 3 Tesla, cardiac function was assessed with a dual breath-hold multi-slice Cine trueFISP technique with PAT (T-SENSE acceleration factor 4) allowing a temporal resolution of 48ms and a matrix of 1922 [2]. For delayed contrast enhancement imaging, single-shot trueFISP phase sensitive inversion recovery (PSIR) images were performed within a single breathhold 15 min after administration of contrast media [3]. 3D-Gd-MR-Angiography of the carotids (resolution 1.0 x 1.0 x 1.0, iPAT factor 3), the abdominal aorta (1.4 x 1.1 x 1.2, iPAT factor 3), the thighs (1.1 x 1.1 x 1.1, iPAT factor 2.), the calves and pedal arteries (1.0 x 1.0 x 1.0, iPAT factor 2) was obtained. A TR-CE-sequence of the lower calf and pedal arteries (1.4 x 1.4 x 1.5, iPAT factor 3, temporal resolution 3.7 s /frame) was performed after repositioning of the patient in order to compensate for a shortened range of table movement in the Magnetom Trio. Finally, high spatial resolution native and contrast-enhanced images of the feet were acquired. Correlation to a group of 200 healthy adults (mean age 55 years) who received a whole body MRI for cardiovascular screening was performed [4].

**Results and Discussion** - All images were of good to excellent diagnostic quality without major artefacts, such as venous overlay, severe dielectric or frequency shift artefacts. Vascular pathologies were substantially more often found in the diabetes group than in the healthy control group. Carotid artery stenosis was observed in 54% of diabetes patients compared to 6% of healthy adults. Renal artery stenosis was seen in 25 % of diabetes patients compared to 0.25% in the healthy control group. Iliac arteries showed atherosclerosis in 63 %, the superficial femoral arteries revealed lesions in 64%. Stenoses of peripheral arteries were seen in 51% (anterior tibial artery), 48 % (posterior tibial artery) and 67% (fibular artery). In the group of healthy adults stenoses of the peripheral arteries were observed in 14%. In 9 patients lesions needing intervention were found. In eight asymptomatic diabetes patients (incidence of 18%) silent myocardial infarctions were detected by positive late enhancement and hypo- to akinetic cardiac function. In 200 healthy adults, only 2 myocardial infarctions (incidence of 1%) were detected. One acute cerebral infarction was noted. Also, chronic ischemic lesions of the brain above the age range and small lacunar defects of the brain were found significantly more often in the diabetes group than in the group of healthy patients. Soft tissue edema of the foot was seen in 4 patients, osteomyelitis was detected in 1 patient, neuropathic foot diseases was found in 3 patients.

**Figures:**



## References:

- [1] Wagner S et al. No. 1970, ISMRM 2005
- [2] Reeder SB. Magn Reson Med. 2005 Sep;54(3):748-54.
- [3] Huber A, et al., Radiology 2005 (in press)
- [4] Kramer H et al., Radiology 2005;236(1):300-10.

**Figure** a) High-grade left internal carotid artery stenosis b) axial section obtained by 3D-reformatting, c) Bilateral high-grade renal artery stenosis, d) Time-resolved TREAT-sequence showing a bilateral total occlusion of the proximal tibial anterior and posterior artery, e) Late enhancement inferolateral revealing a silent myocardial infarction, f) Acute ischemic periventricular lesion in the diffusion weighted images suggesting a acute microembolic cerebral infarction

**Conclusion** - Diabetes causes multiple complications such as vascular stenoses, silent myocardial infarctions, lesions of the brain and foot complications. Compared to a healthy control group, pathologies are substantially more often found in patients with longstanding diabetes. Due to the integration of several technical advances, whole body MRI with PAT, especially at 3T, is a highly promising method for comprehensive disease specific imaging since typical pathologies in diabetics can be identified with high spatial resolution and patients can potentially be treated earlier.