Abdominal Imaging at 7T with a 32-channel Body Array Coil - Initial Results

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Introduction

Application of ultrahighfield-MR (UHF-MR) at 7T on humans mainly focuses on the brain and on the extremities. Due to standing wave effects causing the strong inhomogeneity of the B1-field in the body and abdomen, imaging at 7T in the abdomen is currently only rarely reported [1-3]. We present preliminary results of a 7T single channel transmit/32 channel receive body coil array, which has been designed as two 4x4 arrays of small coil elements with the goal to minimize coil induced B1-inhomogeneities.

Methods

A 32 channel TEM body matrix coil (QED, Mayfield Village, OH, USA) was connected to a 7T human scanner (Siemens, Erlangen, Germany). The coil consists of an anterior and posterior part, each containing three parallel TEM transmit elements and 16 receive elements. The receive elements are arranged in a 4x4 pattern to allow acquiring MR images with parallel acquisition acceleration in all spatial directions. The total diameter of the coil housing is 30 cm. Abdominal images were acquired on a healthy 30y old volunteer using a FLASH sequence with GRAPPA reconstruction (factor 2, 30 reference lines) with different protocols: <u>A) breath hold 3D FLASH</u>, TR/TE=4.5ms/1.68ms, flip angle 5°, matrix size 192·192·144, FOV 300·300·230mm^3, resolution 1.6·1.6·1.6mm^3, BW/Px=300Hz, total acquisition time 42s, coronal orientation. <u>B) 3D high resolution FLASH</u>, TR/TE=6.0ms/3.0ms, flip angle 5°, matrix size 512·512·112, FOV 300·300·224mm^3, resolution 0.6·0.6·2mm^3, BW/Px=300Hz, 4 averages, total acquisition time 374s, coronal orientation. <u>C) 2D multislice FLASH</u>, TR/TE=120ms/3.0ms, 5 slices, 200% distance, thickness 5 mm, flip angle 42°, matrix size 512·308, FOV 340·255mm^2, resolution 0.7·1.2mm^2, BW/Px=490Hz, total acquisition time 37s, transverse orientation.

Results

Fig.1 shows selected uncombined images of the 16 posterior elements of coil, reconstructed from the 30 reference lines of the GRAPPA acquisition, together with one slice from the full dataset (Sequence A, see “Methods”). The latter was combined using a sum-of-squares algorithm. Figure 2 shows images in the spinal canal, demonstrating the high SNR and homogeneous coverage in the coronal plane of the coil array (Sequence B).

Fig. 3 shows a selected transverse slice through the liver acquired with a 2D multislice FLASH sequence (Sequence C) together with a sagittal localizer. The position of the coil in head-feet direction is clearly visible as well as the significant B1 reduction towards the center of the body. In plane homogeneity is still reasonable with only some minor shading of signal in the liver (arrows). No correction for B1-inhomogeneity has been performed on any of the images shown.

Discussion

The coil shows surprisingly good homogeneity parallel to the coil even without B1-shimming. Sensitivity perpendicular to the coil shows a strong gradient, which is mainly due to the sensitivity profile of the small transmitter coils integrated into the receive array. Both the anterior and posterior part of the coil can be operated individually as surface coil in transmit/receive mode, such that imaging of, e.g., the spinal cord is possible during free breathing without artefacts from the abdominal wall. The potential for high acceleration factors for parallel imaging with the 32 channel array will be explored in future work.

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References: [1] Vaughan et al., MRM 61:244-248(2009) [2] Snyder et al., MRM 61:517-524(2009) [3] Wu et al., IEEE T BIO-MED ENG 57(2):397-403(2010)

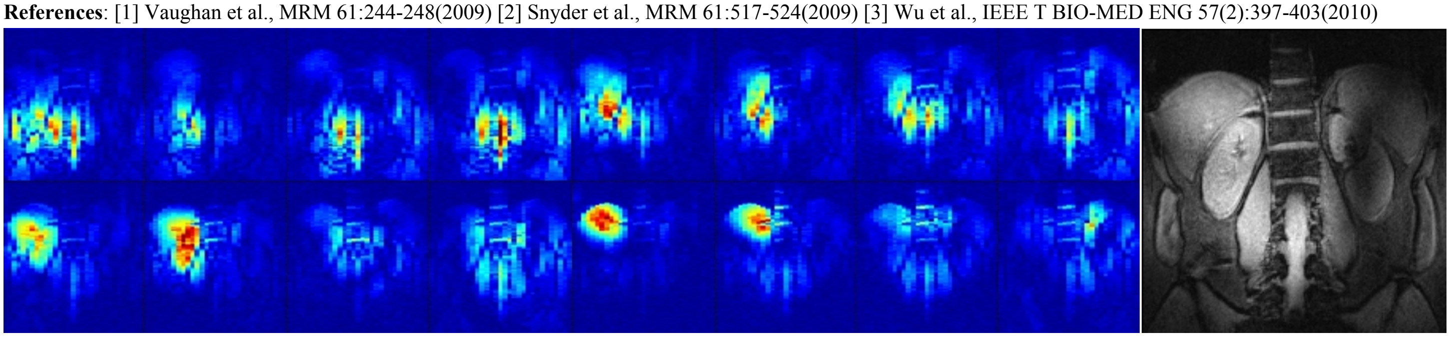

Fig. 1: Low resolution uncombined images of the 16 receiver elements of the posterior coil. Right: High resolution image of the full dataset.

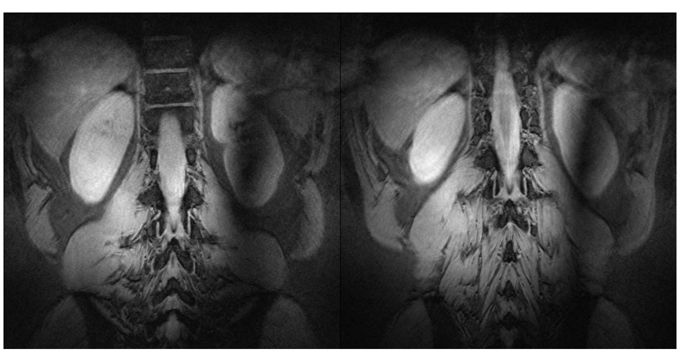

Fig. 2: Two selected slices of high resolution FLASH 3D data showing the spinal canal.

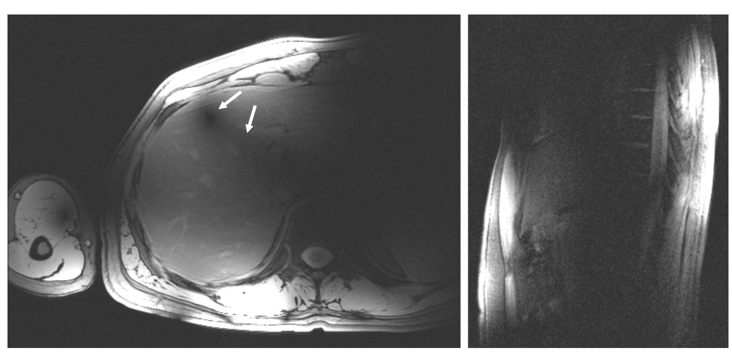

Fig. 3: Selected slice of a 2D multislice FLASH sequence. Right: Sagittal localizer shows position of the two coil parts.