Portable small animal imaging unit for clinical MRI scanners

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Introduction: Imaging small animals in a clinical environment is a challenge. A dedicated rf-coil is necessary to achieve a sufficient signal-to-noise ratio. In general such a coil is not part of the standard equipment of clinical scanners. Still these measurements suffer from the fact, that the gradient strength is limited by the gradient strength of the whole body gradient system. Even though it is possible in some cases to attach an external gradient system, this has to be implemented in the scanner software of the clinical system.
From these necessities we propose a dedicated small imaging unit consisting of a sensitive rf-coil, an optimized microscopy gradient system and a scanner standalone MRI console. This makes the portable small animal imaging unit an independent system, which can be used in any clinical scanner magnets. It has been build for 1.5T and first high resolution mice images are presented.

Materials and Methods: The portable small imaging unit consists of a probe head and an independent imaging console. The probehead is equipped with a transmit-/receive coil and a microscopy gradient system. It is designed for a bore direction perpendicular to the main field direction. The bore diameter is 39mm, sufficient to house mice. The rf-coil is a solenoid coil, offering optimized signal-to-noise ratio. The gradient system delivers high gradient strength in all directions (3D) and due to its low inductance it can be switched in microseconds. It is placed on the patient table with or without extra boxing for the measurement and is centered by table controls in the isocenter of the magnet. The MRI console from Pure Devices includes a high power gradient amplifier and a high power rf-amplifier. Signal cable from the console to the probehead can be either lead through the filter plate, or through the scanner room door using a home build extra flat foil filter. The probehead has been build for 1.5T and measurements have been performed using the magnetic field of a clinical whole body scanner. SNR of this system has been compared with a dedicated 16 channel mice coil using the whole body gradient system and the scanner console.

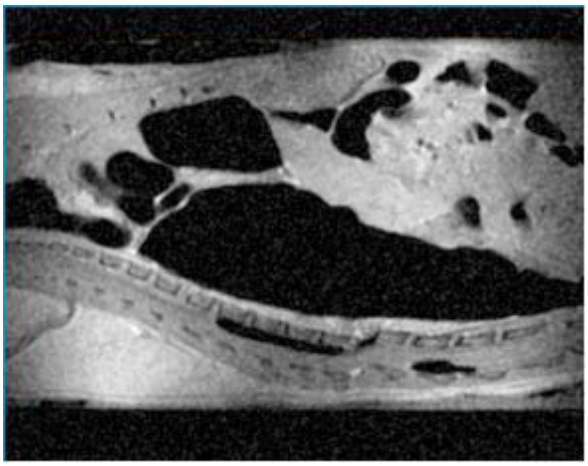

Fig. 1: 2D slice selective spine echo of a mouse. Matrix size: 256x256, TE 10ms, TR 500ms, 16 averages

Results: The complete system consists of the MRI console weighting less than 15kg, the probehead weight with the dimensions 30cm x 20cm x 6cm is less than 2kg. The MRI console includes a 100W rf-amplifier and a 4*50W gradient amplifier. The probehead includes a 3D gradient system with maximal gradient strength of 120mT/m. Compared with the 16 channel RF array mice coil it can be shown that the achieved signal-to-noise ratio is at minimum 30% higher. This is due to the optimized rf-coil amplifier combination. A complete independent operation from the clinical scanner hard- and software (excepting the magnetic field) is possible with the portable standalone imaging unit. Exemplarily a sample 2D slice selective spin echo image is shown in fig.1.

Conclusion: The proposed small imaging unit operates independently from the clinical MRI scanner in a clinical environment. The system is portable and easy to set up in the magnet. It delivers images with high signal-to-noise ratio at high resolution. Additionally it can be isolated by special boxing from the clinical setup.

References:

1. S. Wintzheimer et al. “A straightforward biplanar gradient design for mobile MR: Optimizing a modified maxwell/golay layout with simulated annealing” Proc. ICMRM (2009)