TGRAPPA on Rat Hearts in vivo using a 4-channel receive array at 9.4 T

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Introduction

Cardiac functional studies in surgically or genetically modified mice and rats are typically performed using dedicated volume coils or with a volume coil/transmit – surface coil/receive setup. Required experimental time is about one hour or longer to cover the entire heart. However, the availability of dedicated coil-arrays would improve the sensitivity, and allow the use of parallel imaging techniques (such as SENSE or GRAPPA). These techniques use spatial information from the array to more rapidly encode the image. While well established clinically, their use has not been reported in experimental cardiac MRI. This work presents methods and first results for accelerated cardiac MRI in rats in vivo at 9.4T using TGRAPPA and a dedicated four channel receive array.

Methods

We designed a four-element coil-array optimized for rat hearts. All coil elements were decoupled using a combination of shared inductors and preamplifier decoupling. Imaging was performed on a horizontal 9.4T MR system (VNMRS, Varian Inc.). Fully encoded, double-gated *in vivo* MR images were acquired on Wistar rats (220-250 g) using a fast multi-frame gradient echo (GE) sequence (TE/TR=1.79/4.6ms, NAE=1). From these data, undersampled data sets were generated in post-processing (acceleration factors R=2 and 4). Sum-of-square as well as TGRAPPA reconstruction was performed.

Results

Single coil elements showed high isolation under in vivo conditions (max. noise correlation 36%, mean 25%), and therefore good encoding properties. Overall decoupling of each pair of coil elements was better than -20dB. In Fig. 1E, the sum of squares of the end-diastolic, fully encoded in vivo images from Fig. 1A-D is shown (in plane resolution 100 µm, slice thickness 1.5 mm, scale bar: 5 mm). End-diastolic and end-systolic frames of TGRAPPA are shown in Fig. 2. Note, even a four-fold acceleration provides reasonable image quality in the heart region.

Discussion & Conclusion:

We have developed a dedicated coil array for cardiac MR in the rat. This is the first study to report on the implementation and application of TGRAPPA in experimental cardiac MR. Work is underway to systematically investigate the influence of the accelerated imaging on the accuracy of cardiac functional parameters such as left ventricular mass or volumes, routinely determined in experimental cardiac MR. Our data indicate the feasibility of cardiac exams in rodents to be performed within about 15 minutes.

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FIG 1:

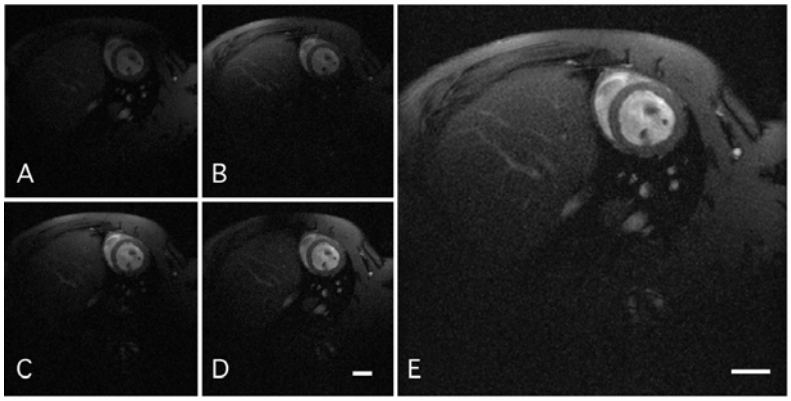

FIG 2: