Half-Fourier Single-Shot Turbo Spin-Echo (HASTE) of the Lung at 3T: Feasibility Study using Parallel Imaging with 32-Receiver Channel Technology

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Introduction: Several studies have shown a high accuracy of half-fourier single-shot turbo spin-echo (HASTE) for the assessment of pulmonary pathology including lung nodules and infiltrates (1, 2). Advantages of HASTE are the short echo spacing and short acquisition time, which makes HASTE relatively resistant to the magnetic susceptibility of the lungs as well as motion artefacts. Previous studies at 1.5 T have shown that by using parallel imaging (with acceleration factors of 2-3) the image resolution of HASTE can be increased in comparison to non-accelerated acquisitions. In addition, T2-decay related effects such as image blurring, can be reduced (3). New 32-channel MRI systems and dedicated receiver coils potentially allow for higher acceleration factors (4). Only limited experience concerning lung imaging at higher field strength (>3T) exists (5, 6). The purpose of this study was to assess the feasibility of HASTE imaging of the lung at 3T using parallel imaging with a dedicated 32-receiver channel technology.

Materials and Methods: 9 healthy volunteers (median age: 28 years) were examined with HASTE on a 32-channel 3T MRI system (Magnetom TIM Trio, Siemens Medical Solutions) using a prototype 32-channel torso array coil (RAPID Biomedical). HASTE MRI (FOV=420x420 mm; matrix=256x256; slice thickness=5 mm) was acquired at both, end-inspiratory and end-expiratory breathhold using parallel imaging (GRAPPA, 64 reference lines) with acceleration factors ranging between 2 and 6. In addition also non-accelerated image data was acquired (no PAT). Depending on the acceleration factor a minimal TE ranged between 42 ms (no PAT) and 16 ms (PAT=6). In a consensus reading by two radiologists, the different images were ranked in a side-by-side comparison regarding the delineation of intrapulmonary anatomical structures, presence of artefacts, and signal-to-noise (with a ranking of "1" considered as the best image and "6" as the worst).

Results: For inspiratory scans, an acceleration factor of 2 showed the best results for the delineation of intrapulmonary anatomy. Presumably, due to the higher proton density in expiratory scans, the best delineation of intrapulmonary anatomy was found for an acceleration factor of 4. In comparison to non-accelerated images image blurring was substantially reduced with parallel imaging. The presence of artefacts and image noise increased with higher acceleration factors.

Conclusion: HASTE MRI of the lung is feasible at 3T. Using optimised scanner technology and optimised multi-element coil geometry acceleration factors up to 4 can be achieved without degradation of the image quality (e.g. due to artefacts and poor signal to noise ratio). Expiratory scanning may be favourable to compensate for susceptibility associated signal loss of the lung at 3T.

References:

1. Vogt FM et al. AJR 2004; 2. Eibel R et al. Radiology, in press ; 3. Heidemann RM et al. MRM 2003;
4. Reeder SB et al. MRM 2005; 5. Uematsu H et al. MRM 2001 ; 6. Lutterbey G et al. Eur Radiol 2005

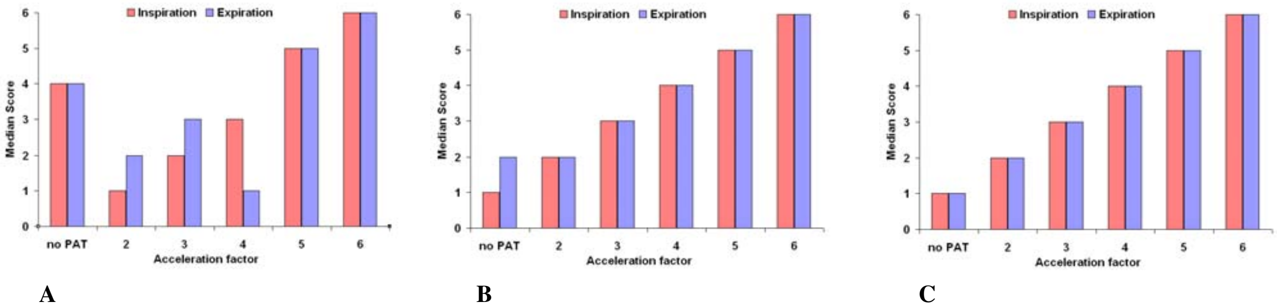

Fig. 1: Ranking of HASTE images acquired with different acceleration factors with regard to delineation of intrapulmonary anatomy (A), presence of artefacts (B), and signal-to-noise ratio (C). Note: a ranking of "1" is considered as the best image and "6" as the worst.

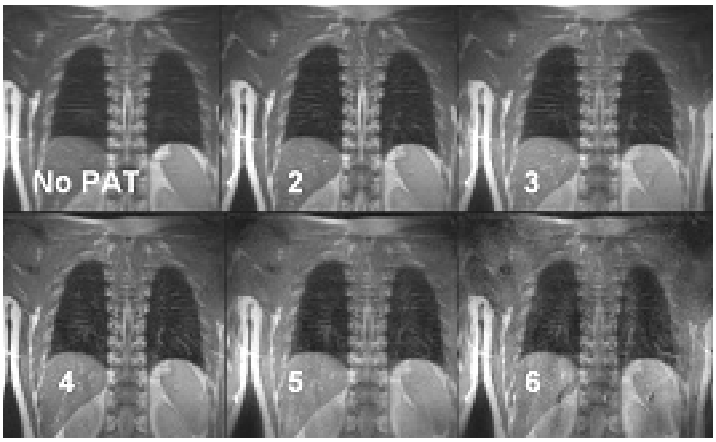

Fig. 2: Expiratory HASTE images of a healthy volunteer acquired with different acceleration factors. An acceleration factor of 4 results in the best delineation of intrapulmonary anatomy with a sufficient signal to noise ratio.