Neuroradiological Applications of Hyperecho-TSE Sequences at 3T: First Clinical Results

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Purpose

Turbo spin echo sequences (TSE) are probably the most supporting pillar of diagnostic MRI due to a direct T1 and/or T2 weighted contrast behavior and their insensitivity to field inhomogeneity effects. One major problem of TSE sequences is their high rf power deposition which can be subdued by rf pulse mechanisms like hyperechoes[1] and TRAPS[2] (hyperTSE sequences). HyperTSE sequences proved to achieve similar contrast and SNR in normal controls compared to conventional TSE180°[1,2]. However, their sensitivity to display pathologies still has to be evaluated in clinical studies. This preliminary study demonstrates that hyperTSE sequences show both, an equivalent capability of resolving pathologies and a contrast to noise ratio between cerebral WM and GM that is at least as good as the conventional TSE's.

Subjects and Methods

All measurements were performed on a 3.0T whole-body imaging system (Siemens Trio, Erlangen, Germany) during normal clinical routine - with additional hyperTSE measurements. A pool of 44 patients was examined so far. **Table 1** displays an overview of the different pathologies imaged. No pathology was excluded in this study. A common TSE sequence (TE/TR=100/5200ms, ETL=19-21, MTX=512x416, in-plane resolution=$(0.4mm)^2$, slth=2mm) was employed, in which the "TRAPS" mechanism with optimized flip angles was implemented as described in [2]. All acquisition times were approximately 4:30min.

pathology	amount
tumors	16
hippocampal sclerosis	6
focal cortical dysplasia (FCD)	10
neonatal injuries	5
others	7

Table 1: Overview of examined pathologies

Results

Figure 1 demonstrates an example of a high resolution T2 weighted hyperTSE image of a male patient (42y) with hippocampal sclerosis, right side. The hyperTSE image displays a very good contrast between WM, GM, and CSF. The right hippocampus clearly shows hyperintense signal and volume loss. The temporal horn of the lateral ventricle is enlarged. **Figure 2** displays another example for the excellent GM/WM contrast of the hyperTSE images. A patient with a dysplastic organization of the cerebellar foliae is shown. The hyperTSE sequence emphasizes the aberrant structure of the cerbellum very well. **Figure 3** presents a comparison between a conventional TSE180° and the novel hyperTSE sequence for a patient with a pilocytic astrocytoma of the chiasma region. Both images clearly identify and characterize the tumor and show an equivalent capability of resolving the lesion. The SAR of all hyperTSE images presented here was reduced to approximately 35% of the equivalent TSE180° sequences (i.e. $SAR_{saving\text{-}hyper}$=65%).

Discussion and Conclusion

As a preliminary result it was demonstrated that hyperTSE sequences and conventional TSE180° have an equivalent capability of resolving different types of pathologies. HyperTSE images show an intrinsinc excellent contrast to noise ratio between WM and GM. In addition, rf power deposition can be drastically reduced by as much as $SAR_{saving\text{-}hyper}$=67%. This reserve in SAR allows more slices per acquisition and a higher ETL for shorter acquisition times with TSE sequences.

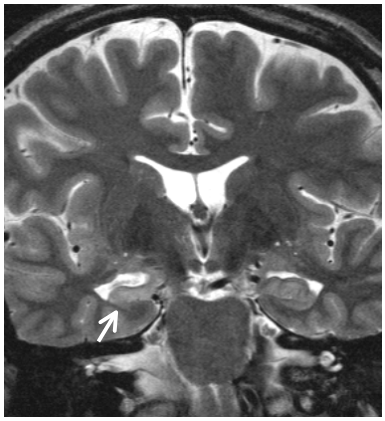

Figure 1: Patient with hippocampal sclerosis, right side (hyperTSE). $SAR_{saving\text{-}hyper}$=67%

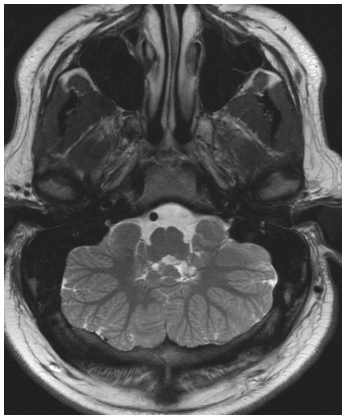

Figure 2: Patient with dysplastic organization of cerebellar foliae (hyperTSE). $SAR_{saving\text{-}hyper}$=63%

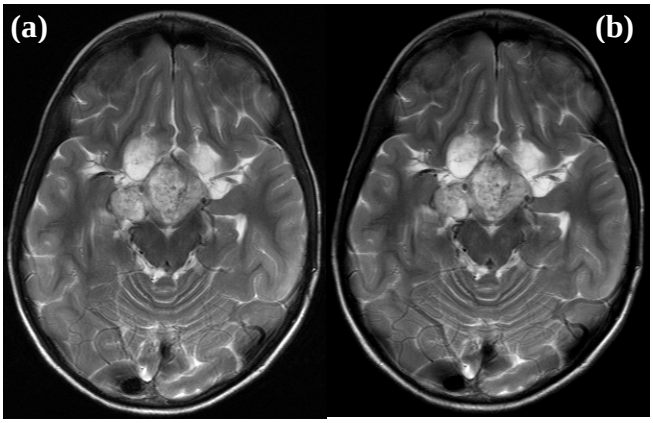

Figure 3: Patient with pilocytic astrocytoma. On the left side is the conventional (a), on the right side the hyperTSE image (b). The saving in SAR was $SAR_{saving\text{-}hyper}$=66% compared to (a).

References:

[1] Hennig J, Scheffler K, MRM 46:6-12

[2] Hennig J, Weigel M, Scheffler K, MRM 49:527-35