T2* Perfusion Imaging at 7.0 Tesla using 3D PRESTO: initial results

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Introduction: 7.0 Tesla ultra high field systems are currently introduced for clinical imaging, especially focusing on high resolution structural imaging and fMRI applications due to the inherent gain of SNR. Single-shot EPI at 7.0 Tesla will suffer from severe distortions, while multi-shot techniques can often not establish the required temporal resolution. Furthermore, a shorter TE will be required at this high field strength which is often not possible with a single-shot approach.

In this abstract we investigated the use of a multi-shot technique with echo-shifting (PRESTO) (1) to overcome some of the distortions and to prevent low temporal resolution.

Purpose: The aim of this study was to test the feasibility of clinically acceptable contrast enhanced T2*-Perfusion at 7.0 Tesla using a PRESTO-Sequence.

Material and Method: The T2*-perfusion imaging study was performed in a male thirty-one year old volunteer using a 3D PRESTO sequence (TR 12.35ms/ TE 18.5ms, effective TR 1s., Slice thickness 3.5mm, 64x64 Matrix, FOV250mm, rFOV 70%, 20 section with no gap covering the supratentorial brain tissue, 150 dynamic scans, total scan time 146s.). The imaging was conducted at a 7.0T system (Achieva 7.0T, Philips Medical Systems, Cleveland, OH, USA). A contrast medium dose of 0.05 mmol/Kg bodyweight (5ml), Gadovist®, Schering, Berlin, Germany was injected via a 14G intravenous catheter after the 5^{th} dynamic acquisition.

The acquired data were transferred to an off-line workstation (Medx 3.4.3, Medical Numerics, Inc., Sterling, Virginia, USA). By the use of a dedicated perfusion analysis software parametric maps for MTT (Mean Transit Time), CBV (cerebral blood volume) and the CBF (cerebral blood flow) were calculated. In addition the maximal T2* (Smax) induced signal drop at the bolus peak was measured. The source images of the perfusion data were inspected visually for image distortions. The color-coded parametric maps were judged for image quality, and the number of non fitted voxels was rated. The calculated time-intensity-curves from the dynamic data as visually inspected and the sharpness of the bolus peak were evaluated.

Quantification of the perfusion data was done using the Medx package. AIF was estimated in the large brain feeding vessels near the skull base and CBF (cerebral blood flow) was calculated after AIF deconvolution. A region of interest analysis was performed in several regions of the white and gray matter for MTT, CBV, CBF, and Smax.

Results: Only minor image distortions were seen in the source data. Clear and sharp bolus peaks could be visualized for the gray and white matter without a plateau shaped saturation at bolus peak time. The mean MTT was 11.9s for the gray matter and 9.2s for the white matter. Gray matter CBV was 34.4, and 8.1 for the white matter respectively. A mean CBF of 54.3 ml per minute per 100g was measured in the white matter and a CBF of 165.4 ml per minute per 100g was measured in the gray matter. The mean measured Smax for the gray matter was 54.7% and 21% for the white matter.

Conclusion: 3D perfusion imaging (PRESTO) is feasible at 7.0T even without parallel imaging techniques. Further significant improvements can be expected when parallel imaging techniques are available for 7.0 T, which is to be expected in the very near future.

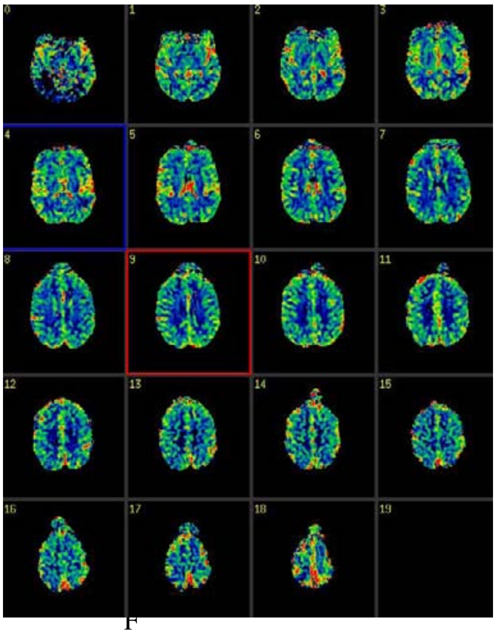

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Fig.1 Parametric CBV map acquired at 7.0T

Reference:

1. Liu G, Sobering G, Duyn J, Moonen CT. A functional MRI technique combining principles of echo-shifting with a train of observations (PRESTO). Magn Reson Med 1993; 30:764-768