Optimization of 3D-PRESTO (principles of echo shifting with a train of observations) sequence forT2* sensitized High-Resolution MR-Venography

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Introduction:

PRESTO (Principles of Echo-Shifting with a Train of Observations) is a unique sequence that combines elements of echo-shifted gradient-recalled MR imaging with the acquisition of all k-space lines within a single TR period. This can reduce acquisition time by shifting the gradient echo over one or more repetition times resulting in TE > TR. Therefore, PRESTO is a fast T2* sensitized scan. Recently susceptibility-weighted imaging (SWI) has been introduced in clinical neuroimaging and its clinical usefulness has been reported. SWI, however, consists of both magnitude and phase images and post-processing is necessary to multiply a phase mask over the magnitude data

Purpose:

The purpose of this study was to optimize 3D-PRESTO sequence for the imaging of deep cerebral venous anatomy.

Materials and Methods:

All examinations were performed on a 1.5T MR scanner (Intera Master, Philips Medical Systems). The following examinations were performed:

(a) Previous to the optimization of 3D-PRESTO, we compared the three sequences of 3D-PRESTO, 3D-GRE(gradient recalled echo), and 3D-GRE-EPI. A cerebral parenchymal phantom (PVA: polyvinyl alcohol gel and human venous blood) was examined with these three sequences and the contrast to noise ratio (CNR) between PVA gel and blood was calculated. The parameters for the imaging were: TR/TE 27/40 for 3D-PRESTO, 68/40 for 3D-GRE and 3D-GRE-EPI, flip angle 20 degrees.

(b) 3D-PRESTO parameters were applied to the cerebral parenchymal phantom with various flip angles (10 to 50, every 10 degrees) (TR/TE 26/40), with various TE (25-55, every 5 ms. TR was automatically changed when various TE was employed.) (flip angle 20 degrees), and with various EPI factors of 3, 5, and 7(TR/TE 26/40, flip angle 20 degrees). The CNR between PVA gel and blood was calculated.

(c) As results from (b), optimized 3D-PRESTO sequence was applied to a small vessel phantom (agars and polyurethane strings of various diameters; 0.18, 0.3, 0.5, 0.8, and 1mm). High resolution isotropic voxel of 0.49 x 0.49 x 0.5 mm was employed to the imaging. The images were transferred to AZE Virtual Place workstaion and minimum intensity projection (MinIP) images were obtained.

(d) MR venography of 3D-PRESTO in five healthy volunteers was obtained with as close as optimized parameters.

Result:

(a)3D-PRESTO had the higher CNR (13) .5of than that of 3D-GRE-EPI (11.2) or 3D-GRE (4.64). (b) The highest CNR was obtained on 3D-PRESTO with flip angle of 20 degrees, TR/TE of 31/45 ms, and EPI factor of 3 (Figure 1). (c) MinIP images obtained 3D-PRESTO could visual the polyurethane strings of the diameter > 0.3 mm. (d) For volunteers study, the parameters of TE 38/48, flip angle of 10 and 20 degrees, and EPI factor 3 were employed. Figure 2 represented deep cerebral venography. The internal cerebral, direct lateral, anterior caudate, septal, and medullary veins were clearly seen on MinIP images.

Conclusion:

With optimized parameters, 3D-PRESTO can provide excellent CNR, high resolution isotropic voxels, and T2* sensitized MR Venography. Although flip angle of 20 degrees had the highest CNR in the phantom study, clinical images of both flip angle of 10 and 20 degrees were available different background contrast.

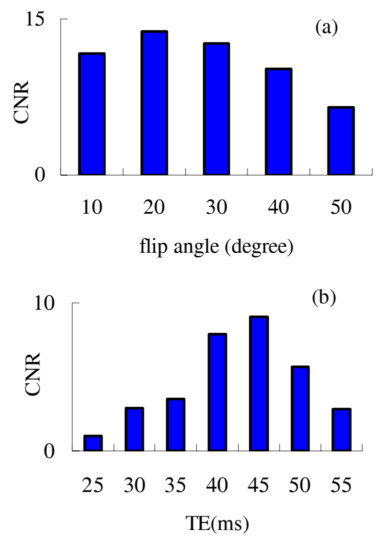

Figure1. CNR in 3D-PRESTO related with flip angle (a) and TE (b)

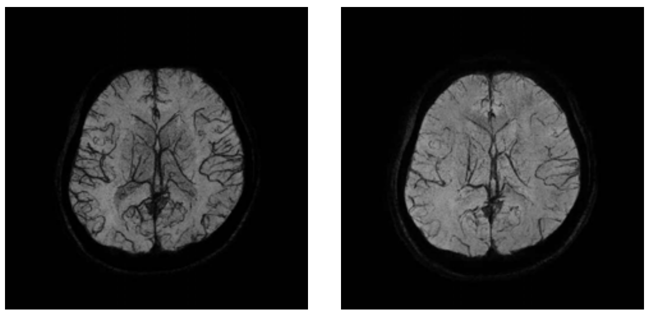

Figure2. The image of flip angle 20 degrees (Left) and 10 degrees (Right)