T2* sensitized high resolution MR venography using 3D-PRESTO (principles of echo shifting with a train of observations)

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Introduction:

Recently susceptibility-weighted imaging (SWI) has been reported to be useful in clinical neuroimaging, because small veins and microbleeds are made increasingly visible. But it needs post-processing to multiply a phase mask over the magnitude data, and this can limit the prevalence of this sequence. 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. Therefore, PRESTO is a fast T2* sensitized scan.

Purpose:

The purpose of this study was to evaluate if 3D-PRESTO could reveal small veins and microbleeds in human brains.

Materials and Methods:

1) Volunteer study: Seven healthy volunteers were examined by 1.5T system (Intera Master, Philips Medical System) with a 6 channel head coil. High resolution gradient-echo images were obtained using 3D-PRESTO sequence with the following parameters: TR=40-46ms, TE=50-56ms, FA=20 degrees, FOV=250mm, 100 slices with 0.5mm thickness, matrix=512*512, voxel size=0.49*0.49*0.50mm, scan times=9 minutes with multishot EPI technique. The data sets were transferred to AZE Virtual Place Workstation and minimum intensity projections (MinIP) axial images were obtained by over 10mm, 15mm, and 20mm. Three radiologists evaluated if deep brain venous anatomy (the internal cerebral vein, the direct lateral vein, the anterior caudate vein, and the septal vein) was identified, and counted the visible medullary veins in the left cerebral hemisphere at the slice level of the anterior caudate vein.

2) Patient study: Patients with brain diseases (vascular malformation, trauma, infarction, tumor) were examined with 3D-PRESTO sequence. The parameters were a little modified (slice thickness=0.75mm) to reduce the scan time up to 4 minutes. Acquired images were evaluated if abnormal small veins and microbleeds could be identified.

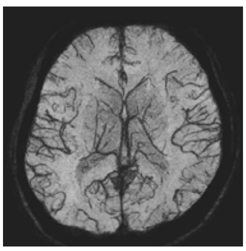
Results:

In all volunteer studies, the deep brain venous anatomy was readily identified in each MinIP image (fig.1). The mean numbers of counted left medullary veins were 5.1, 5.9, and 6.7 in 10mm, 15mm, and 20mm MinIP images, respectively. The difference was significant between 10mm and 20mm MinIP images ($p=0.02$).

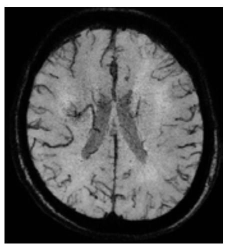
In patient studies of this method, small abnormal veins including the drainage veins of venous angiomas (fig.2) and the cerebral infarctions were clearly revealed. Microbleeds related to brain contusion, cavernous angiomas and brain neoplasms could also be identified easily.

Conclusion:

High resolution MR venography using 3D-PRESTO could depict small veins and microbleeds. It may be an alternative method to SWI.



(fig.1)



(fig.2)