Ultra high resolution venography using T2* weighted imaging at 7T MRI

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Introduction

Throughout the last two decades, MRI has been ameliorated by a dramatic increase in the field strength; from 0.015 to 7 Tesla (T) MR systems. Ultra-high-field MR system (beyond 3T) has great potential to produce newly improved imaging capabilities for both clinical diagnosis and basic science research. The primary purpose of venography was the description of cerebral veins, but it has also been applied successfully in imaging of stroke, multiple sclerosis, tumors or hemorrhagic lesions. By now susceptibility weighted imaging (SWI) has played part of the clinical diagnosis at 1.5T and 3.0T MR scanning [1,2]. Recently, studies have reported the potential of venography study at 7T MRI [3]. The aim of this study was to optimize and to evaluate ultra high resolution 3D venography for the visualization of micro-cerebral veins at 7 T MRI.

Methods

Gradient echo sequence was used for venography at 7T MRI system (Magnetom, Siemens, Germany). We have tried to find the optimal echo time to obtain maximum contrast between blood and brain tissue, and evaluated the imaging resolution for ultra high resolution venography. The influence of echo time on venography in vivo was investigated in one volunteer at 7T, in which data was acquired at echo times of 8 msec,11 msec, and 14 msec with TR / α = 25 msec / 25°, matrix = 336 x 384, voxel size = 0.5 x 0.5 x 1 mm^3, and acquisition time = 8:58. Multi-channel and birdcage coils were compared for selection of optimal RF coil. We also compared the venography at 7T MRI with those of conventional MRIs, such as 1.5T and 3T, with each optimized MR parameters. We used 0.3 x 0.3 x 0.3 mm^3 of imaging resolution for ultra high resolution venography. We visualized the data using minimum-intensity-projection (min-IP) technique with 15 mm thickness.

Results

Optimal TE was found to be around 14 msec as shown in Fig 1 (right). Shorter TE could not provide high vessel contrast (left and middle). Using this optimal TE, we compared the venography images from different coil types, such as 8-channel and birdcage coils. The 8-channel coil was robust to show the micro veins which are located on the peripheral of brain as shown in Fig 2 (left), while birdcage coil was good to represent the central cerebral veins (right). The higher field strength, such as 7T MRI, produced the better resolution image as shown in Fig 3 (right), compared to lower field strength such as 1.5T (left) and 3T (middle) MRIs.

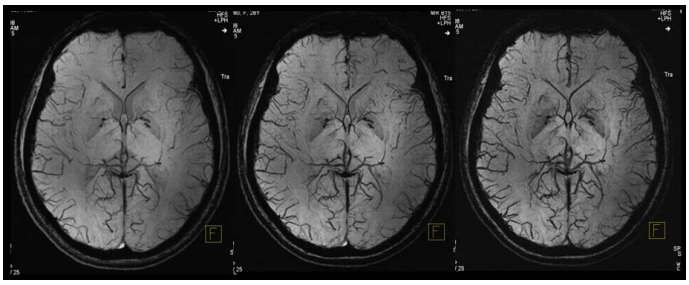

Fig 1. Venography with different TEs

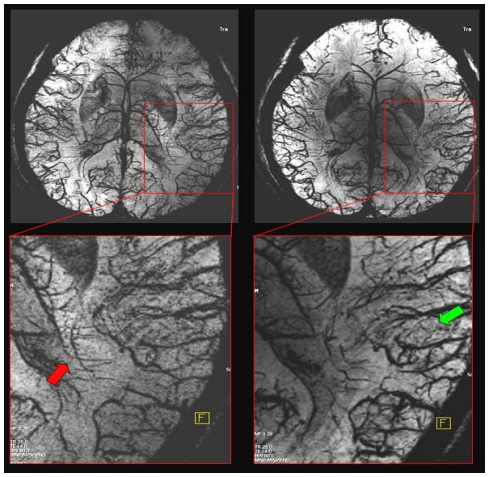

Fig 2. Comparison of multi-channel and birdcage coils

Discussion

Ultra-high resolution venography at 7.0T was obtained by using multi-channel sense coil and birdcage coil. Depended on location of veins, each coil represents well certain part of micro cerebral veins. Therefore, it indicated that it may be very important to select an optimal RF coil for specific applications. The optimal echo time was found to be 14 msec at 7T, which was similar with other group [4]. Ultra-high resolution venography at 7.0T reveals extremely fine cerebral venous anatomical details that may aid in characterizing active or necrotic stroke and monitoring treatment effects. Ultra high resolution venography offers spectrum of current clinical applications and may improve our knowledge of the pathophysiology of acute stroke.

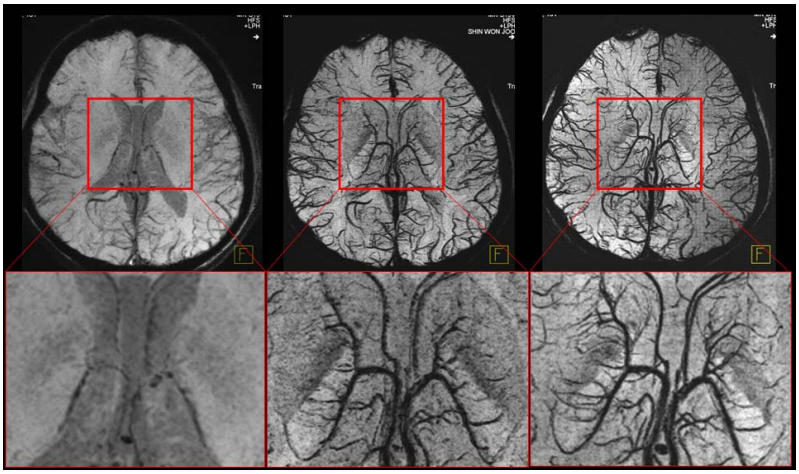

Fig 3. Comparison of venography at different MRIs

Reference

[1]Yablonskiy et al., Magn Reson Med 1994;32:749-763.
[2]Andreas D, et al., Magn Reson Med 2008;60:1155-1168
[3] Deistung A, et al., Magn Reson Med 2008;60:1155-68
[4] Peter JK, et al, Magn Reson Mater Phy 2008;21:149-58.