DIRECT VISUALIZATION OF NORMAL SUBTHALAMIC NUCLEUS WITH HIGH RESOLUTION MR IMAGING AT 3.0 T: COMPARISON BETWEEN FSE T2-WI AND FAST STIR IMAGE

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Introduction

The subthalamic nucleus (STN) is known to be as the target region of electrode implantation plus continuous high frequency stimulation by means of a pacemaker for advanced Parkinson's disease. A combination of anatomic imaging with a stereotactic frame, atlas coordinates, and intraoperative neurophysiology is currently considered the most reliable approach for STN targeting. Recently MR imaging is also employed for direct visualization of STN (1, 2); the STN was identified as hypointense region on T2-weighted image, because the STN contains rich iron. Short inversion time inversion-recovery (STIR) image seems also useful for visualization of the STN because of good contrast between gray and white matter (3). The purpose of this study was to compare the visibility of the normal STN between high-resolution fast spin-echo T2-weighted images (FSE T2-WI) and fast STIR images at 3.0-T.

Methods

A total of 24 neurologically normal cases (12 women, 12 men; age range, 32-86 years; mean age 56.0 years) were prospectively included in this study. Coronal FSE T2-WI (TR/TE/NEX 4000/84.1/3, ETL 14) and fast STIR (TR/TE/NEX 5000/20.9/2, ETL 10, TI 120msec) images perpendicular to the AC-PC line with a 2.5-mm thickness with no gap, a FOV of 20cm, and a matrix of 512x320 were acquired at a 3.0-T MRI system (Excite HD, GE). The definition of the STN on MR imaging was determined by referring to the Schaltenbrand and Wahren atlas. For the qualitative study, two radiologists scored the visibilities of the three (upper, lower and lateral) margins of the STN using a four-point scale on both FSE T2-WI and fast STIR images by consensus. For the quantitative study, the difference of signal intensity (SI) between the STN and adjacent structures: substantia nigra which locates just below the STN and the white matter, was calculated on both sequences as follows: $[(SI_{STN} - SI_{adjacent\ structure})/SI_{adjacent\ structure}]$. We used the signed-ranks test and paired t-test to assess differences in visibility of the STN between two sequences.

Results: The STN could be identified in all cases as hypointensity on FSE T2-WI and slight hypointensity on fast STIR image (Fig. 1). The visibilities of upper and lateral margins of the STN on FSE T2-WI was significantly superior to those on fast STIR image ($p<0.05$), and the visibility of lower margin of the STN on fast STIR image was significantly superior to that on FSE T2-WI ($p<0.05$). The difference of signal intensity between the STN and substantia nigra was significantly higher on fast STIR than that on FSE T2-WI ($p<0.05$). There was no statistically significant difference in the difference of signal intensity between the STN and white matter on both FSE T2-WI and fast STIR images.

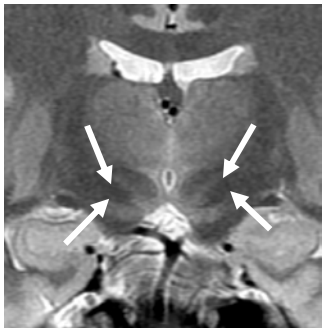

Fig1-1. STN on fast STIR image

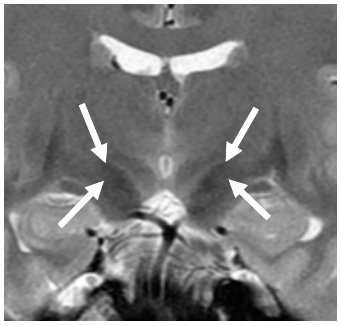

Fig1-2. STN on FSE T2-weighted image

Conclusion: Both high resolution MR images, FSE T2-WI and fast STIR at 3T, appear to be an excellent tool for direct visualization of the whole structure of the STN, and combined reading of both images will improve the identification of the whole STN.

Reference

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(2) Slavin KV et al. AJNR Am J Neuroradiol 2006;27:80-84
(3) Oikawa H et al. AJNR Am J Neuroradiol 2002;23:1747-1756