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Signal intensity of decussation of the superior cerebellar peduncle on sagittal T1WI: correlation with age and gender☆

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Abstract

Purpose: Decussation of the superior cerebellar peduncle (DSCP) usually shows low signal intensity (SI) on midsagittal T1-weighted imaging (T1WI) in neurologically normal brain. However, the SI change of DSCP with age and gender is not identified. This study aimed to investigate the relationship between SI of the DSCP and age and gender in healthy subjects. **Materials and methods:** Spin-echo (SE) midsagittal T1WI of 120 neurologically normal subjects (52 men, 68 women; age range: 4–64 years, mean age: 31 years) were evaluated retrospectively. Contrast-to-noise ratio (CNR) of the DSCP compared with that of the superior midbrain was calculated. One-way analysis of variance and bivariate correlation analysis were performed to evaluate the effects of gender and age. **Results:** The CNR was significantly lower in the DSCP than in the superior midbrain ($P<.001$). The CNR of DSCP was not correlated with gender ($P=.118$) and age ($P=.764$). **Conclusion:** The low SI of DSCP on midsagittal T1WI showed no correlation with gender or age in healthy subjects.

Keywords: Signal intensity; Superior cerebellar peduncle; Magnetic resonance imaging (MRI)

1. Introduction

Decussation of the superior cerebellar peduncle (DSCP) is usually affected by many diseases, such as Friedreich's ataxia [1,2], Parkinson's disease [3], schizophrenia [4,5], progressive supranuclear palsy [3,6–9], and Joubert syndrome [10–14]. Many radiological modalities have been used to depict the DSCP and superior cerebellar peduncle (SCP), such as diffusion-weighted imaging (DWI) [1,3], fluid attenuated inversion recovery (FLAIR) [4], proton density-weighted imaging (PDWI) [5], diffusion tensor imaging (DTI) [4,5,10,15–20], T1-weighed imaging (T1WI) [11,15], and functional magnetic resonance imaging (fMRI) [12]. These studies, however, are used to evaluate diseases related to DSCP. A few of them are focused on the imaging of the intact DSCP.

DSCP with low signal intensity (SI) on midsagittal T1WI in neurologically normal brain has been used as a landmark to identify the DSCP [11]. To recognize abnormally decreased SI in the DSCP on T1WI, reference standards for the normal and physiologically hypointense DSCP are required. Our purpose for this study was to evaluate the signal characteristics of the DSCP on sagittal T1WI and its relation to patients' gender and age.

2. Materials and methods

Written informed consent was waived and the institutional review committee approved this study.

2.1. Patients

One hundred and twenty patients (52 men, 68 women; age range, 4–64 years; mean age, 31 years) were recruited in this study. The recruited criteria included normal findings at neurologic examination, no history of neurologic disease,

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Table 1
Distribution of patients according to age and gender

Patient age (years)	Number of patients (male/female)
4–10	18 (8/10)
11–20	20 (15/5)
21–30	21 (5/16)
31–40	22 (6/16)
41–50	20 (10/10)
51–64	19 (8/11)
Total	120 (52/68)

and negative brain MRI findings. Indications for MR examination included headache (n=55), dizziness (n=38), and paresthesia (n=27). Their age data are shown in Table 1.

2.2. MR Imaging protocol

All MRI examinations were performed on a 1.5-T imager (Siemens Medical Systems, Avanto, Germany). The protocol included sagittal T1WI (TR/TE, 450/11; three signals averaged; matrix, 512×512; section thickness, 3 mm; no intersection gap; and FOV, 190 mm), T2WI (TR/TE, 4000/99; one signal averaged), and axial FLAIR sequences (TR/TE/TI, 9000/99/2500; one signal averaged). All routine sequences were performed using identical parameters for number of slices, matrix size (256×256), field of view (230 mm), slice thickness (5 mm), and intersection gap (1.5 mm).

2.3. Image evaluation

2.3.1. Qualitative evaluation

The SCP decussation at the level of the inferior midbrain was identified on the basis of the previously defined methods [11,15]. An ill-defined area of lower T1 signal in the inferior midbrain was considered as a sign of SCP decussation [11].

SI of the DSCP was compared with that of the superior midbrain and graded with a three-point coring system: SI of the DSCP was graded as hypointense (Grade 1), isointense (Grade 2), and hyperintense (Grade 3) compared with the SI of the superior midbrain (Fig. 1).

The evaluation was conducted by two radiologists (Q.K., 25 years of experience, and Y. X., 22 years of experience) independently. They were blind to each other and to the clinical information. Discrepancies in T1 prolongation grading were resolved by consensus.

2.3.2. Quantitative evaluation

The analysis of ROI was performed on midsagittal T1WI by a single investigator (Q.K.), who was blind to subject information. For quantitative interpretation, assessment of the SIs was done by placing circular ROIs in the DSCP, superior midbrain, and the background of images (Fig. 1). Background signal was measured in the pontine basement on the same image. Noise was defined as the standard deviation (SD) of the SI within a ROI outside the head (i.e., air).

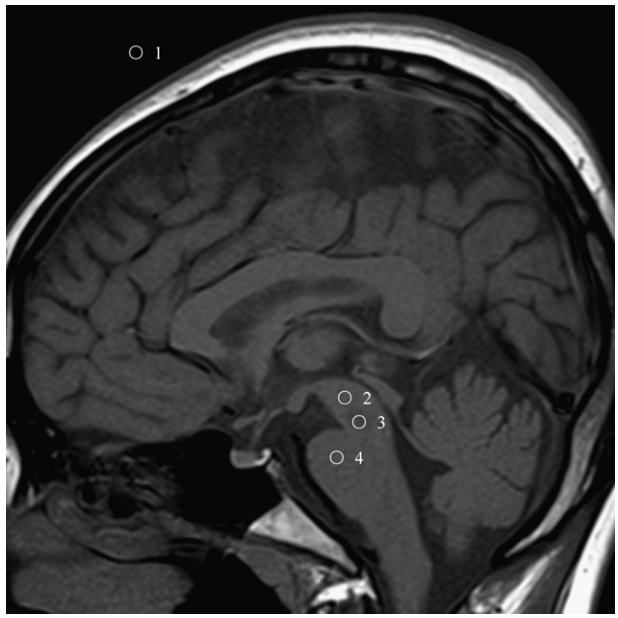

Fig. 1. Sagittal T1WI (TR/TE=450/11) in the midline section shows the positioning of ROIs on the background of the image, superior midbrain, DSCP, and pontine basement, respectively.

DSCP-to-background contrast-to-noise ratio (CNR) and superior midbrain-to-background CNR were calculated. DSCP-to-background CNR was defined as the difference between the signals from the DSCP and pontine basement divided by the SD of measured image noise. Similar calculations were conducted for superior midbrain-to-background CNR.

SI of the superior midbrain was compared with that of the DSCP because (a) both the superior midbrain and the DSCP are parts of the midbrain; (b) the DSCP and superior midbrain are well depicted on the same section at the midsagittal image.

2.4. Statistical analysis

Two-paired samples t test was used to evaluate the SI difference between DSCP and superior midbrain. One-way analysis of variance (ANOVA) was used to test the effects of patients' gender and age on the SIs. Bivariate correlation analysis was also used to evaluate the effect of age on SIs.

Statistical analysis was performed using commercial statistical software (Statistical Package for the Social Sciences, version 16.0; SPSS, Chicago, IL, USA). P values <.05 were considered significantly significant.

3. Results

Twenty percent of the DSCPs were isointense (24/120) and 80% were hypointense (96/120) compared to the superior midbrain. The grades of the SI of the DSCP with respect to age groups are shown in Table 2. In contrast, a