T2* Relaxometry for Quantitative MR Imaging of Iron Deposits in Substantia Nigra of Parkinson¡¯s Disease Brain

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Introduction

There has been a number of efforts to quantitatively measure the brain iron content using MRI (1, 2). The iron deposit has been known to be associated with the physiology and functions of many diseases. In particular, an increase in iron concentration in substantia nigra (SN) of patients with Parkinson's disease (PD) has been reported in postmortem studies (3). Although the iron deposit in the brain causes decreased signal intensity in T_2 – weighted MR images, the exact estimation of the iron content in the MRI relies on T_2* values (susceptibility artifacts), not on T2 values (spin-spin relaxation times) (2) . The iron content can be assessed by measuring T_2* values in the MRI with employing proper correction of field inhomogeneities, which effectively reduces the local field inhomogeneities that are originated from macroscopic susceptibilities present in the regions of air/tissue interfaces (4). In this study, we measured ΔB_0 corrected T_2^* maps to estimate T_2^* values in SN of PD patients to see whether the T_2* values can be a direct reflection of the iron deposits in the SN of Parkinson's disease. The result of this study may suggest a potential of T_2* mapping as a diagnostic imaging method for Parkinson's disease.

Materials and Methods

Clinically suspected Parkinsonism (n=17, M:F= 9:8) and age-matched controls (n=18, M:F=7:11) were prospectively performed at a 3.0T whole body MRI scanner (Achieva, Philips Medical System). Patients with Parkinsonism were clinically diagnosed as the idiopathic PD (n=9, M:F=7:2), secondary PD (n=5, M:F=1:4), and multisystemic atrophy (n=3, M:F=1:2). The T_2^* maps with ΔB_0 correction were calculated using a multishot EPI gradient echo sequence with EPI factor = 63, TR/TE = 95/3.3 ms, FA = 30^o, slice thickness = 3 mm, 3 slices, FOV = 230 x 230 mm^2, MTX= 256 x 256, as described by Dahnke *et al*. (4) The T_2^* values were read from region of interest (ROI) drawn at both SNs on the calculated T_2^* maps using IDL 6.5 (Interactive Data Language). .

Results and Discussion

As shown in the Table 1, the mean T_2^* values of the SN in patients with idiopathic PD were significantly shorter than those in control subjects. However, no statistically significant difference between the patients with secondary PD and control subjects was observed. The representative T2* maps demonstrate shortening of T_2^* values in both SNs compared to an age matched control subject (Fig. 1).

Conclusion

The result of this study suggests us a potential of the T_2* relaxometry to estimate the iron content in the brain *in vivo* accumulated by pathologic condition. In the current study, the T_2* relaxometry seems to adequately reflect the iron content in the SN of PD, which has an added value for diagnosis of PD. This method can also be used to estimate the iron content in the brain accumulated by direct administration of contrast agent such as SPIO.

Figure 1. The representative T_2* maps of PD patient (left) and an age matched control (right). The arrows indicate SNs that have shortened T_2* values due to iron deposits.

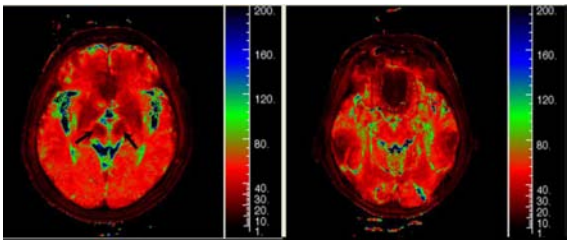

Table 1. The calculated T_2* values of substantia niagra (SN).

	mean age (range)	T2* relaxation times (mean ± SD, ms)	
		Rt. SN	Lt. SN
Idiopathic PD (n=7)	70 (66-82) (*p* = 0.18)	34.6 ± 4.4 (*p* = 0.02)	35.1 ± 4.0 (*p* = 0.05)
Secondary PD (n=5)	71 (63-79) (*p* = 0.29)	37.1 ± 4.7 (*p* = 0.18)	37.5 ± 5.9 (*p* = 0.27)
Multisystemic atrophy (n=3)	71 (66-76) (*p* = 0.39)	33.1 ± 4.1 (*p* = 0.05)	33.8 ± 3.7 (*p* = 0.09)
Control (n=18)	69 (51-83)	40.6 ± 5.3	39.8 ± 5.8

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