CEST MR Imaging Investigation of Parkinson Disease at 3 T

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TARGET AUDIENCE – Neurologists and radiologists who pay attention to diagnosis of PD.

PURPOSE

To investigate whether chemical exchange saturation transfer (CEST[1]) MR imaging is helpful in the evaluation of PD.

METHODS

Twelve PD patients with a mean age of 64 years (range 59-70 years) and twelve age-match normal controls (mean age 66 years) were recruited for this study. All patients and controls were imaged on a 3 Tesla Philips MR system, using a 8-channel head coil. APT-MR imaging was based on single-slice, single-shot TSE (saturation time = 800 ms; saturation power = 2 μT). Magnetization transfer spectra with 31 different frequency offsets (-6 to 6 ppm, interval 0.25~0.5 ppm) were acquired in two transverse slices of the head, including basal ganglia and midbrain. MTR_{asym} at 3.5 ppm and 1.5ppm was calculated according to: MTR_{asym} = MTR(+offset) - MTR(-offset). FLAIR imaging was used as anatomical reference to draw ROIs (caudate, globus pallidus, putamen, substantia nigra, and red nucleus). Independent t-test was used to compare the MTR_{asym} of PD patients and normal controls.

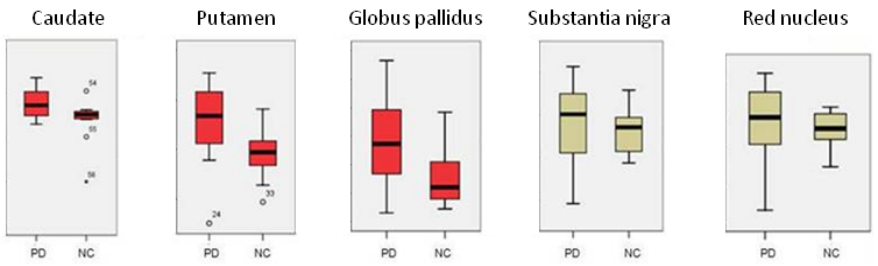

Fig. 1. MTR_{asym}(3.5ppm) signal intensity plots of several different brain areas. Red color means significant differences between PD and normal controls (NC), while yellow means no significant differences. n = 12 each group.

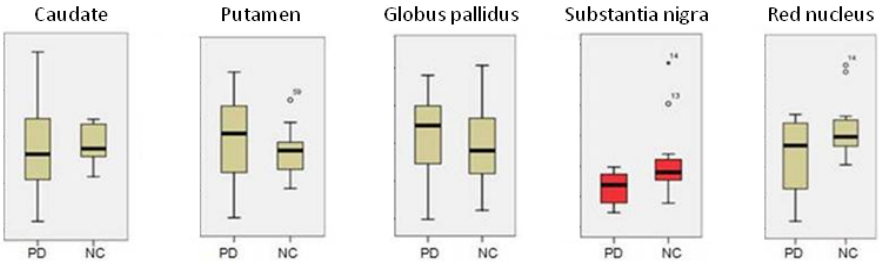

Fig. 2. MTR_{asym}(1.5ppm) signal intensity plots of several different brain areas. Red color means significant differences between PD and normal controls (NC), while yellow means no significant differences. n = 12 each group.

RESULTS AND DISCUSSION

MTR_{asym}(3.5ppm) of caput nuclei caudate, putamen and globus pallidus in PD patients was significantly higher than normal controls ($P < 0.05$) (Fig. 1), while MTR_{asym}(1.5ppm) of substantia nigra was significantly lower in PD patients than normal controls ($P < 0.05$) (Fig. 2). In the present study, our quantitative analysis was focused on MTR_{asym}(3.5ppm) and MTR_{asym}(1.5ppm) signals. From our results, MTR_{asym}(3.5ppm) of caput nuclei caudate, putamen and globus pallidus was higher in PD patients than in normal controls, which may mainly be associated with increased cytosolic proteins, peptides, or amino acids[2,3]. The most interesting finding was that MTR_{asym}(1.5ppm) of substantia nigra was significantly lower in PD patients than in normal controls. We suppose that MTR_{asym}(1.5ppm) may have the potential to predict the dopamine content, although it still needs further research to confirm it. We expect that APT MR imaging at 7 T has more advantages to detect the CEST signal of dopamine.

CONCLUSION

Our preliminary results show that CEST MR imaging may have the potential to detect changes in the mobile protein and dopamine content in PD patients that may be useful for the non-invasive imaging diagnosis of PD.

REFERENCES

1. Ward, K.M., et al., J. Magn. Reson., 2000;143:79-87. 2. Zhou, J., et al., Nat. Med., 2011;17:130-134. 3. Cai, K.J., Nat. Med., 2012;18(2):302-306.