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## REAL TIME CHANGE OF PREFRONTAL CORTEX ACTIVITY RELATED TO NORMAL AND ABNORMAL BLADDER FILLING IN PARKINSON DISEASE: A FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (fNIRS) STUDY

### Hypothesis / aims of study

Patients with Parkinson's disease (PD) frequently have lower urinary tract dysfunction (LUTD). The mechanism of LUTD in PD was partly clarified and it was reported that nigrostriatal degeneration resulted in micturition hyper-reflexia (i.e. detrusor overactivity). However the association between other central nervous systems and LUTD in PD have yet been uncertain. The prefrontal cortex has been mainly implicated in executive function such as decision making, planning behaviours and controlling social behaviour (the ability to suppress urges that, if not suppressed, could lead to unacceptable outcomes), and these functions are disturbed in patients with PD. The prefrontal cortex has been also regarded as a higher centre for micturition, and it is hypothesized that this part is involved in bladder function such as planning and suppressing micturition. Recently functional neuroimaging studies using PET, fMRI and SPECT have shown activation of prefrontal area during withholding of urine or a full bladder. A part of these findings was reported to be abnormally weak in patients with urge incontinence or detrusor overactivity. Last year, we also preliminarily showed that changes of oxy-Hb concentration in prefrontal cortex in patient with normal and abnormal bladder filling by using functional near-infrared spectroscopy (fNIRS) and that fNIRS was useful in monitoring the cortical activity in response to lower urinary tract function in humans. In this time, we noninvasively showed the real time change of oxy-Hb in prefrontal cortex in patients with PD and evaluated the association between prefrontal cortex and LUTD in PD.

### Study design, materials and methods

We recruited 6 patients with PD, who were informed consent and different from the subjects in preliminary study last year; 3 women and 3 men; mean age 60 years (55-61), untreated and 4 patients had detrusor overactivity during bladder filling. The fNIRS probe was placed on two area (right and left) of the subject's frontal head, and we measured oxy-Hb concentration in bilateral anterior parts of prefrontal cortex (may be Brodmann's area 9, 10) during bladder filling in cystometry by fNIRS (NIRO 200, Hamamatsu Photonics Inc, Japan). The oxy-Hb concentration was calculated by the Beer-Lambert method.

### Results

In patients with PD, oxy-Hb concentration gradually increased in bilateral anterior parts of prefrontal cortex from the start to end of bladder filling. However, regardless of the appearance of detrusor overactivity, this rate was smaller than our data in other subjects without detrusor overactivity. And the rate in patients with detrusor overactivity was smaller than that without detrusor overactivity. Furthermore, the specific change of oxy-Hb concentration was shown under detrusor overactivity during bladder filling in real time; oxy-Hb spontaneously increased at the beginning of detrusor overactivity and oxy-Hb concentration remarkably decreased under detrusor overactivity occurring. There was no significant difference in oxy-Hb concentration between right and left prefrontal cortex.

### Interpretation of results

fNIRS in patients with PD showed that, compared with the change of oxy-Hb concentration in bilateral prefrontal cortex in other subjects without detrusor overactivity, total increasing rate of the oxy-Hb concentration was small, and that specific oxy-Hb change related to detrusor overactivity occurred. These findings suggest that poor response to the bladder filling in prefrontal cortex may be involved in the LUTD in patients with PD and specific change of oxy-Hb concentration in this area may be related to a cause of detrusor overactivity; ie dysinhibition of micturition reflex.

### Concluding message

We showed the specific changes of oxy-Hb concentration synchronised with normal and abnormal bladder filling in bilateral prefrontal cortex of patients with PD by using fNIRS. In patients with PD, dysfunction of prefrontal cortex may be involved in LUTD, in particular detrusor overactivity.

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| <b>What were the subjects in the study?</b>             | <b>HUMAN</b>                              |
| <b>Was this study approved by an ethics committee?</b>  | <b>Yes</b>                                |
| <b>Specify Name of Ethics Committee</b>                 | <b>Chiba University, Ethics Committee</b> |
| <b>Was the Declaration of Helsinki followed?</b>        | <b>Yes</b>                                |
| <b>Was informed consent obtained from the patients?</b> | <b>Yes</b>                                |