513 The subthalamic stimulation inhibit bladder contraction by modulating local field potential and catecholamine in the medial prefrontal cortex

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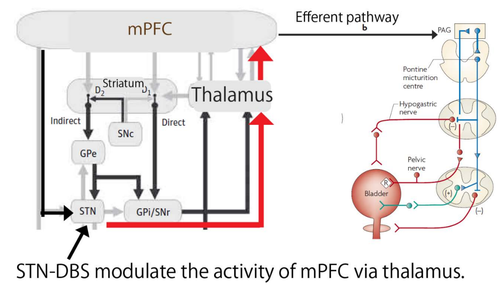
Hypothesis/aims of study

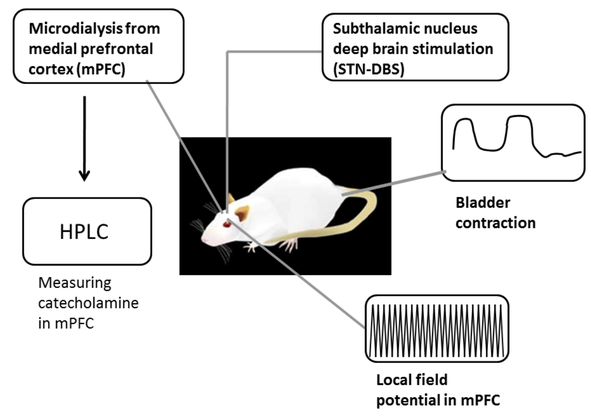
The subthalamic nucleus deep brain stimulation (STN-DBS) is widely used for alleviating motor complications in the advanced stage of patients with Parkinson's disease (PD). Although lower urinary tract symptoms (LUTS) such as overactive bladder (OAB) are also prevalent in advanced stage of PD, the efficacy of STN-DBS on LUTS are not well elucidated. The medial prefrontal cortex (mPFC) is known as higher micturition centre and receives output signal of basal ganglia which is highly modulated by STN-DBS. Therefore, STN-DBS might regulate bladder contraction by changing the activity of mPFC. We aimed to clarify the changes in neuronal activity (local field potential and levels of catecholamine) of mPFC induced by STN-DBS with relation to bladder contraction using normal and PD model rats.

Study design, materials and methods

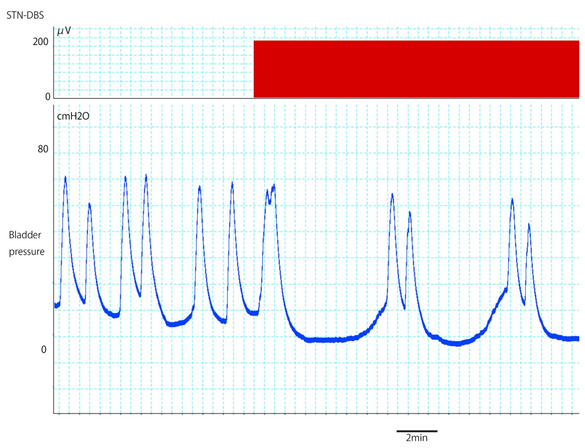
Experiments were performed under urethane anesthesia in normal and 6-hydroxydopamine hemi-lesioned PD model rats. STN-DBS was applied to the left STN, and bladder contractions were monitored simultaneously. Local field potential (LFP) in mPFC was recorded before, during and after STN-DBS (n=6: normal rats, n=6: PD rats). Extracellular fluid in mPFC was collected before, during, and after STN-DBS (n=5: normal rats, n=6: PD rats).Each experiments were performed separately. Spectral analysis of LFP for calculating beta power was performed, and the levels of catecholamine were measured.



STN-DBS modulate the activity of mPFC via thalamus.



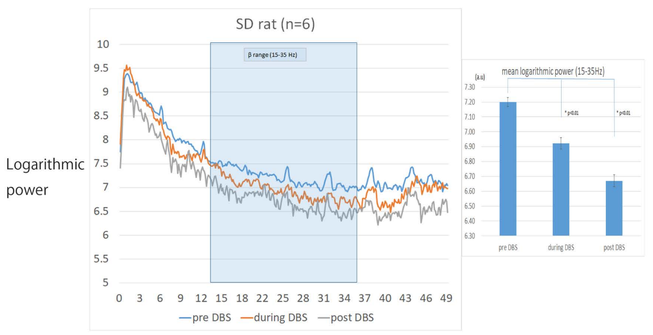
Results



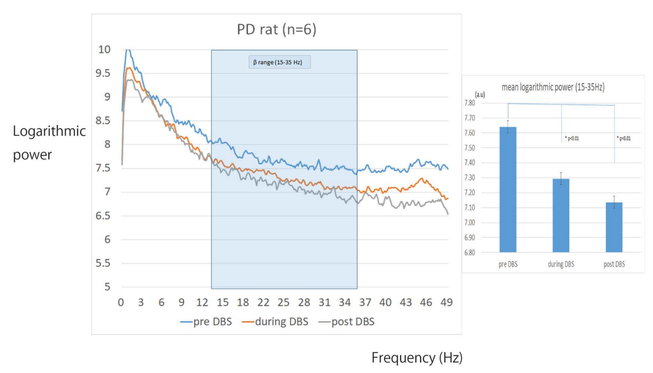
STN-DBS significantly increased inter bladder contraction interval in normal and PD rats.

(sec)	pre	during	post	p-value (pre vs during)
PD rat	175.2±16.3	231.1±26.3	221.4±25.0	p=0.05
SD rat	155.4±23.4	260.4±39.1	209.4±36.3	p=0.01
p-value (SD vs PD)	p=0.17	p=0.03	p=0.17	

(a)

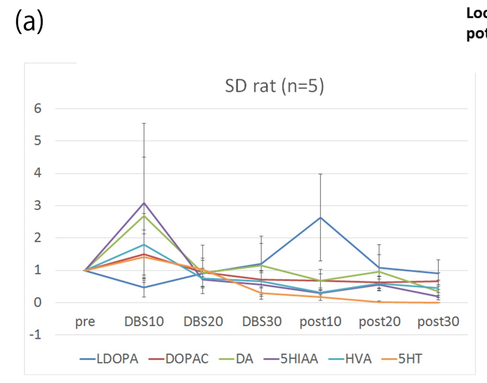


(b)

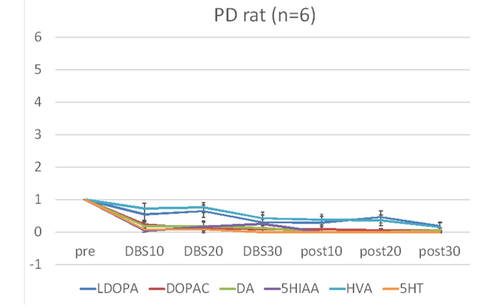


The beta power in mPFC was significantly decreased during and after STN-DBS in normal and PD rats.

(a)



(b)



The levels of levodopa, dopamine, serotonin and their metabolites in mPFC were significantly decreased during and after STN-DBS in PD rats, whereas the levels of serotonin and its metabolite and homovanillic acid (HVA) were significantly decreased after STN-DBS in normal rats.

Discussion

The present study demonstrated that STN-DBS significantly increased the inter bladder contraction interval in normal and PD rats. The effect of STN-DBS on the inter bladder contraction interval was larger in normal rats (SD rats) than that in PD rats. The concomitant changes in mPFC induced by STN-DBS was significant reduction in the mean logarithmic power in beta frequency in normal and PD rats. Regarding the levels of catecholamine, 5-HIAA and 5-HT were significantly decreased after STN-DBS in normal rats (SD rat), whereas the both dopamine and serotonin and their metabolites were significantly decreased after STN-DBS in PD model rats. Because, several experimental studies and functional imaging studies suggested that the mPFC plays the important role in regulating micturition reflex in both human and animal, and the STN-DBS might significantly affect the function of mPFC via the output nuclei of basal ganglia (GPi/SNr) and thalamus, the present study indicated that STN-DBS increased the inter bladder contraction interval via decreasing the beta power of mPFC and the levels of catecholamines in m PFC in normal and PD rats. Furthermore, the present study also revealed that the effect of STN-DBS on the levels of catecholamines were different between normal and PD model rats.

Conclusion

- STN-DBS could increase inter bladder contraction interval in normal and PD rats probably by changing the neural activity as evaluated by the beta power and catecholamine levels in mPFC.
- The effect of STN-DBS on the levels of catecholamine in mPFC was different between normal and PD rats.