

PROGRAM BOOK

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· Date

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· Venue

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Abstract Book

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Break-up and Recovery of Harmony between Direct and Indirect Pathways in The Basal Ganglia; Huntington's Disease and Treatment

Sang-Yoon Kim, Woochang Lim

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The basal ganglia (BG) in the brain exhibit diverse functions for motor, cognition, and emotion. Such BG functions could be made via competitive harmony between the two competing pathways, direct pathway (DP) (facilitating movement) and indirect pathway (IP) (suppressing movement). As a result of break-up of harmony between DP and IP, there appear pathological states with disorder for movement, cognition, and psychiatry. In this paper, we are concerned about the Huntington's disease (HD), which is a genetic neurodegenerative disorder causing involuntary movement and severe cognitive and psychiatric symptoms. For the HD, the number of D2 SPNs (N_{D2}) is decreased due to degenerative loss, and hence, by decreasing x_{D2} (fraction of N_{D2}), we investigate break-up of harmony between DP and IP in terms of their competition degree C_d , given by the ratio of strength of DP (S_{DP}) to strength of IP (S_{IP}) (i.e., $C_d = S_{DP} / S_{IP}$). In the case of HD, the IP is under-active, in contrast to the case of Parkinson's disease with over-active IP, which results in increase in C_d (from the normal value). Thus, hyperkinetic dyskinesia such as chorea (involuntary jerky movement) occurs. We also investigate treatment of HD, based on optogenetics and GP ablation, by increasing strength of IP, resulting in recovery of harmony between DP and IP. Finally, we study effect of loss of healthy synapses of all the BG cells on HD. Due to loss of healthy synapses, disharmony between DP and IP increases, leading to worsen symptoms of the HD.

Keywords: Basal ganglia, Huntington's disease, Direct pathway (DP), Indirect pathways(IP), Harmony between DP and IP, Competition degree, Optogenetics