Anodal transcranial direct current stimulation prevents methyl-4-phenyl-1,2,3,6-tetrahydropyridine induced neurotoxicity as a in vivo mouse model of Parkinson's disease through autophagy modulation

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Background: Parkinson's disease (PD) is a neurodegenerative disorder characterized by accumulation of protein inclusions and loss of dopaminergic neurons. Transcranial direct current stimulation (tDCS) is a non-invasive brain stimulation technique that has demonstrated promising results in clinical studies of PD. Despite accumulating evidence have proved the protective effect of tDCS, the mechanism of action is still unknown. Autophagy is thought to be one of the important mechanism in the development of PD, and recent studies have demonstrated dysregulation of the autophagy pathway in the PD patients and animal PD models. The present study, we firstly investigated the neuroprotective effect of tDCS in 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) induced PD mouse model, and then evaluate the effect of tDCS on autophagy pathway. Methods: Mice were stimulated for consecutive 5 days with MPTP treatment. After observation of behavioral alteration using Rota-rod test, mice were sacrificed for the measurement of the PD and autophagy related protein levels in substantia nigra. Results: tDCS improved the behavioral alteration and tyrosine hydroxylase protein level and suppressed α-synuclein protein level in MPTP-treated mice. MPTP-treated mice with tDCS also decreased the level of autophagy-related protein, such as microtubule-associated protein 1 light chain 3 and AMP-activated protein kinase and increased the level of mechanistic target of rapamycin and p62. In addition, the protein level of phosphoinositide 3-kinase and brain derived neurotrophic factor were enhanced and unc-51-like kinase 1 was suppressed by tDCS in MPTP-treated mice. Conclusions: Our findings suggested that tDCS protects against MPTP-induced PD mouse model through modulation of autophagy.