

Effect of Tai-Chi and Cyclic Meditation on Hemodynamic Responses of the Prefrontal Cortex: A Functional near Infrared Spectroscopy

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Abstract : Meditation is a self-regulated conscious process associated with improved awareness, perception, attention and overall performance. Different traditional origin of meditation technique may have different effects on autonomic activity and brain functions. Based on this quest, the present study evaluated the effect of Tai-Chi Chuan (TCC, a Chinese movement based meditation technique) and Cyclic Meditation (CM, an Indian traditional based stimulation and relaxation meditation technique) on the hemodynamic responses of the prefrontal cortex (PFC) and autonomic functions (such as R-R interval of heart rate variability and respiration). These two meditation practices were compared with simple walking. Employing 64 channel near infrared spectroscopy (NIRS), we measured hemoglobin concentration change (i.e., Oxyhemoglobin [ΔHbO], Deoxyhemoglobin [ΔHbR] and Total hemoglobin change [ΔTHC]) in the bilateral PFC before and after TCC, CM and Walking in young college students ($n=25$; average mean age \pm SD; 23.4 ± 3.1 years). We observed the left PFC activity predominantly modulates sympathetic activity effects during the Tai-Chi whereas CM showed changes on right PFC with vagal dominance. However, the changes in oxyhemoglobin and total blood volume change after Tai-Chi was significant higher ($p < 0.05$, t -maps) on the left hemisphere, whereas after CM, there was a significant increase in oxyhemoglobin ($p < 0.01$) with a decrease in deoxyhemoglobin ($p < 0.05$) on right PFC. The normal walking showed decrease in Oxyhemoglobin with an increase in deoxyhemoglobin on left PFC. The autonomic functions result showed a significant increase in RR- interval ($p < 0.05$) along with significant reductions in HR ($p < 0.05$) in CM, whereas Tai-chi session showed significant increase in HR ($p < 0.05$) when compared to walking session. Within a group analysis showed a significant reduction in RR-I and significant increase in HR both in Tai-chi and walking sessions. The CM showed there were a significant improvement in the RR - interval of HRV ($p < 0.01$) with the reduction of heart rate and breath rate ($p < 0.05$). The result suggested that Tai-Chi and CM both have a positive effect on left and right prefrontal cortex and increase sympathovagal balance (alertful rest) in autonomic nervous system activity.

Keywords : brain, hemodynamic responses, yoga, meditation, Tai-Chi Chuan (TCC), walking, heart rate variability (HRV)

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