**Anodal transcranial direct current stimulation (tDCS) improves impaired cerebrovascular reactivity in the healthy and traumatized mouse brain**

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**Abstract:** Traumatic brain injury (TBI) results in long-term functional disability in 70% of survivors but is still without clinically proven therapeutic intervention. In a recent study on a mouse model of TBI we have demonstrated that anodal tDCS restores cerebral blood flow (CBF) and tissue oxygenation via dilatation of cerebral arterioles thereby improving neurologic outcome. Here we evaluate effect of tDCS on impaired cerebrovascular reactivity (CVR). *Methods:* TBI was induced by controlled cortical impact (CCI). Cortical microvascular tone, microvascular cerebral blood flow (mCBF) and tissue oxygenation (NADH) were measured by two-photon laser scanning microscopy before and after tDCS. Anodal tDCS (0.1 mA/15min) or sham stimulation was done under anesthesia. CVR was evaluated by measuring changes in arteriolar diameters and NADH (tissue oxygenation) during hypercapnia test before and after tDCS. Transient hypercapnia was induced by 60 second increase of CO2 concentration in the inhalation mixture from 0 to 10%. *Results:* As in previous our studies, anodal tDCS dilated arterioles, which increased arteriolar blood flow volume that led to increasing in capillary RBC flow velocity and the number of functioning capillaries improving tissue oxygenation in both, traumatized and sham animals. In sham mice, transient hypercapnia caused transient dilatation arterioles (17.8%, P<0.05) with constant NADH, reflecting intact cerebrovascular reactivity and autoregulation. In TBI animals, arteriolar dilatation response to hypercapnia was les (6%, P<0.05) while NADH level increased by 9%, P<0.05 (tissue oxygenation decreased), reflecting impaired cerebrovascular reactivity and autoregulation. Anodal tDCS enhanced reactivity in both groups (P<0.05), especially in TBI mice, were improved cerebrovascular reactivity prevented the reduction in tissue oxygenation during hypercapnia (P<0.01). *Conclusions:* Cerebral vasodilatation and vasoreactivity improvement have been shown to be related to nitric oxide elevation due to nitric oxide synthases activation, which can be sensitive to the electrical field induced by tDCS and require further investigation.

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