

## **Safety of anodal transcranial direct current stimulation with respect to blood-brain barrier permeability in the rat**

### **ABSTRACT**

Transcranial direct current stimulation (tDCS) is currently used based on its potential to treat a wide range of neurological diseases. Although previous studies have demonstrated an intensity-dependent effect of anodal tDCS, few studies have evaluated the safety of this procedure regarding the permeability of the blood-brain barrier (BBB). Therefore, the present study aimed to determine the safety of anodal tDCS in terms of BBB permeability in rats because maintenance of BBB function during tDCS is particularly important to protect the brain from foreign substances, and to maintain a stable environment. For the present study, an electrode was directly fixed onto the cranium and anodal tDCS was applied using a constant current stimulator that delivered a 500  $\mu$ A current for 30 min. Possible BBB dysfunction was assessed by intravenously administering Evans blue dye and performing immunohistochemical analyses of the tight junction protein Claudin-5. Anodal tDCS did not affect BBB permeability or Claudin-5 expression levels, even under relatively high current stimulus conditions; specifically, 144.9 A/m<sup>2</sup> for 30 min (i.e., 260820 C/m<sup>2</sup>). Although further studies will be necessary, the present results indicate that anodal tDCS is relatively safe compared to cathodal tDCS.

**Keyword:** Electric stimulation; tDCS; Permeability; Blood brain barrier; Claudin-5