

Blood-brain barrier derangement after electrical brain stimulation

ABSTRACT

Noninvasive brain stimulation methods, including repetitive transcranial magnetic stimulation and transcranial direct current stimulation (tDCS), have received considerable attention in recent years for use in the study and treatment of neurological conditions. Of these methods, tDCS is considered particularly promising due to its ease of use and ability to confer polarity-dependent effects on brain excitability, making it an excellent option for clinical treatment of neurological and psychiatric diseases. While generally regarded as safe when following standard protocols, the effects of tDCS on cerebral blood vessels and blood-brain barrier (BBB) functions remain poorly understood. Here, we provide an overview of tDCS in the context of BBB function, summarize the current literature, and discuss implications for future research. To date, no alterations or damage to the BBB have been reported after weak tDCS stimulations in human subjects; however, some animal studies have reported alterations to BBB function following increased tDCS intensity, with inconsistencies in the effective tDCS polarity used to produce these BBB disruptions between studies. Further research will be necessary to evaluate the effects of tDCS on the BBB under various conditions. Finally, we discuss the potential of tDCS for enhancing drug delivery to the central nervous system, which may become possible as we refine our understanding of the effects of tDCS on BBB permeability.

Keyword: Electric brain stimulation; Transcranial direct current stimulation (tDCS); Blood brain barrier (BBB); BBB permeability; Neurological disorders; Drug delivery; Therapeutic window