What Psychiatrists Need to Know About Transcranial Direct Current Stimulation

By Marom Bikson, PhD, Gozde Unal, MS, Andre Brunoni, MD, PhD and Colleen Loo, MD

October 24, 2017

Volume: 34

Special Reports, Neuropsychiatry

Transcranial direct current stimulation (tDCS) is a low-intensity, noninvasive form of brain stimulation delivered by a small battery-powered portable machine. Conventionally, 2 disposable electrodes are positioned on the head, and a small current is passed between these electrodes to stimulate the brain "transcranially." A typical session uses a low-intensity current of 1 to 2 mA (ECT by comparison is 800 mA), which is given continuously for about 30 minutes. Also in contrast to ECT, the tDCS current is continuous (not pulsed) and flows in one direction from the anode electrode to the cathode electrode ("direct current").

Only a fraction of the current reaches the brain —it passes through the skin, skull, and cerebrospinal fluid —but the excitative qualities of the brain and its plasticity make it sensitive to even a low level of direct current stimulation. The injected electric current does not generate action potentials per se, but modulates ongoing brain activity and influences synaptic transmission, with effects on brain function that outlast the stimulation session. The potential to produce lasting changes in brain function with tDCS, especially after repeated sessions of stimulation, has encouraged clinical trials for the treatment of psychiatric and neurological disorders.

Initial tDCS protocols suggest that the anode and cathode electrodes can induce excitatory or inhibitory effects, respectively, in the underlying cortex. More recently, it was found that the direction of the effects also depends on other parameters, such as current intensity, session duration, brain state, and any concurrent pharmacology.[1] Other distinct forms of low-intensity transcranial electric stimulation also exist, such as alternating, pulsed, or random noise ("tRNS") electric stimulation. However, clinical research is currently most advanced with direct current.

The regulatory status of tDCS in the US is as an investigational device. In the European Union, Canada, Brazil, Australia, and Singapore, specific tDCS products have been approved for the treatment of various neuropsychiatric disorders.

Adverse effects

Mild adverse effects during the stimulation session, such as skin redness, itching, and burning sensation are common, although these effects are generally well tolerated and limited to the duration of the sessions. There are case reports of tDCS-induced induction of manic and hypomanic episodes in patients with mood disorders. A recent meta-analysis found that the risk of manic switch is not statistically higher in patients receiving active (3.5%) compared with sham (0.5%) stimulation, although this analysis is limited by the low number of reports.

Currently, more than 50,000 sessions of tDCS have been used to treat more than 5000 participants in clinical studies. There have been no reports of serious adverse events (ie, hospitalization, seizures, cardiac arrest, death) associated with tDCS.[1] Animal safety studies have shown that the clinical dose is over an order of magnitude lower than the minimum dose required to induce brain injury. Studies in humans showed that tDCS does not increase blood enolase (a marker of brain injury) levels. Several recent meta-analyses have concluded tDCS is well tolerated.[2] The balance of evidence, therefore, shows that tDCS is a safe technique, within the parameters currently used.

RELATED ARTICLES

Neuropsychiatry of TBI

Neurobiology and Clinical Management of Childhood Onset Schizophrenia

Introduction: Convergence of Thought?

Child Psychiatrists: On the Front-lines of Neuropsychiatry

ADHD Neuroimaging: What's New?