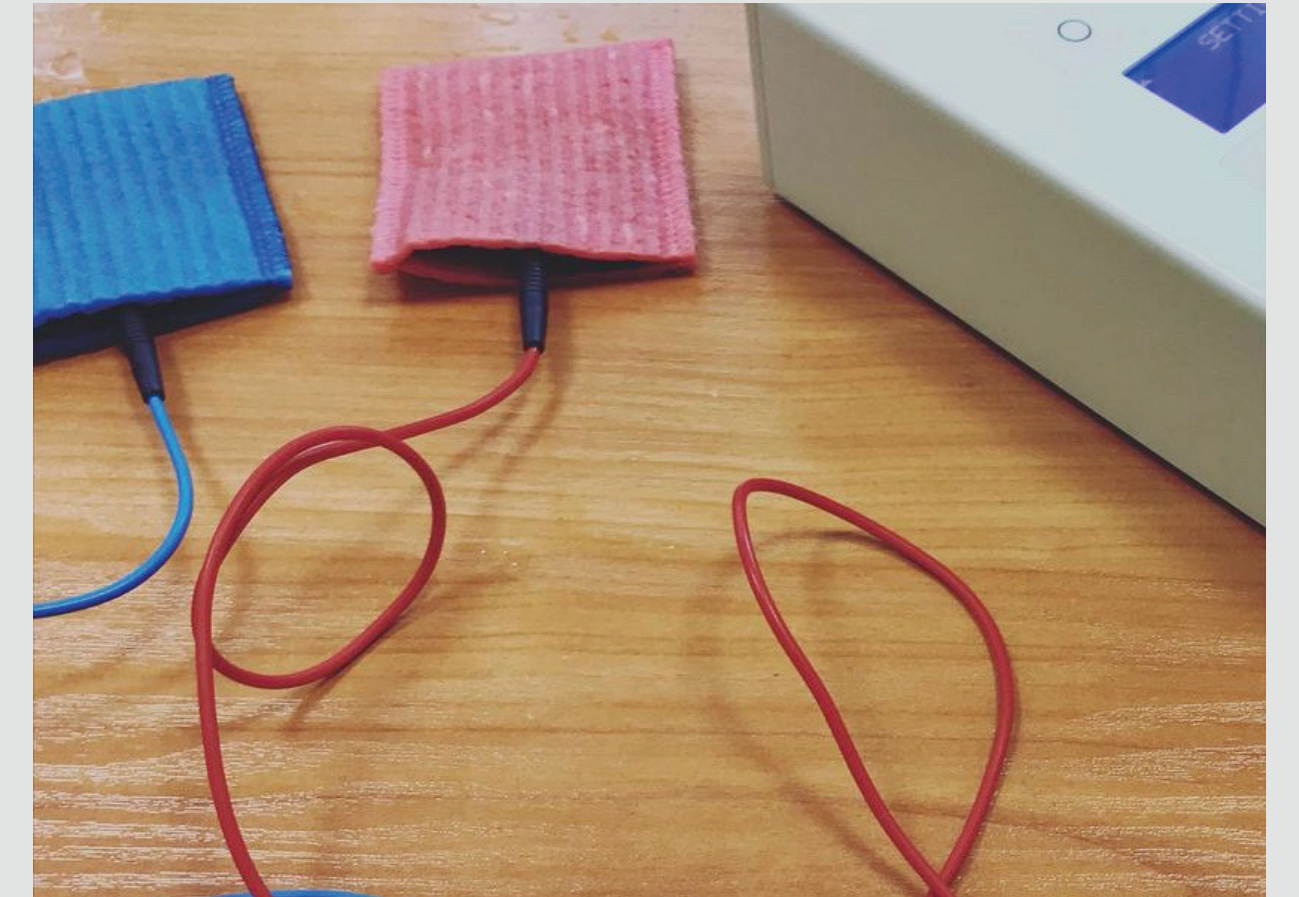


The use of transcranial direct current stimulation in the treatment of drug - resistant auditory hallucinations in patients with schizophrenia

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Transcranial direct current stimulation (tDCS) is a modern and best-studied variant of non-invasive electrical stimulation of the brain. It is a form of neuromodulation with the use of very low-intensity direct current to modulate the activity of neurons in the cerebral cortex. DCS uses a low electric current (2000 μ A (2 mA), the current source is a 9-volt battery). Through a system of at least two electrodes, this current is applied to the surface of the patient's head. After penetration into the brain, there is a change in the resting potential of neurons located in the stimulation area. Within the area stimulated by the polarizing electrode (anode), there is an increase in the resting potential, which increases the likelihood of triggering an action potential under the influence of the incoming electrical/chemical stimulus. This effect is reversed in the area supplied by the depolarizing electrode (cathode), where the resting potential is lowered (hyperpolarized), making it less likely to induce a resting potential. There are computer models that show that these changes occur not only in the areas of the cerebral cortex directly below the electrodes, but also in the cortical and subcortical areas located between the electrodes. Due to the possibility of modifying the size and number of electrodes, this method allows for precise stimulation/inhibition of selected areas of the brain. Important for the durability of clinical effects is the fact that the modulation of the membrane potential persists after the end of stimulation. This phenomenon is based on the mechanism of long-term synaptic potentiation.



DC-STIMULATOR PLUS

INTRODUCTION

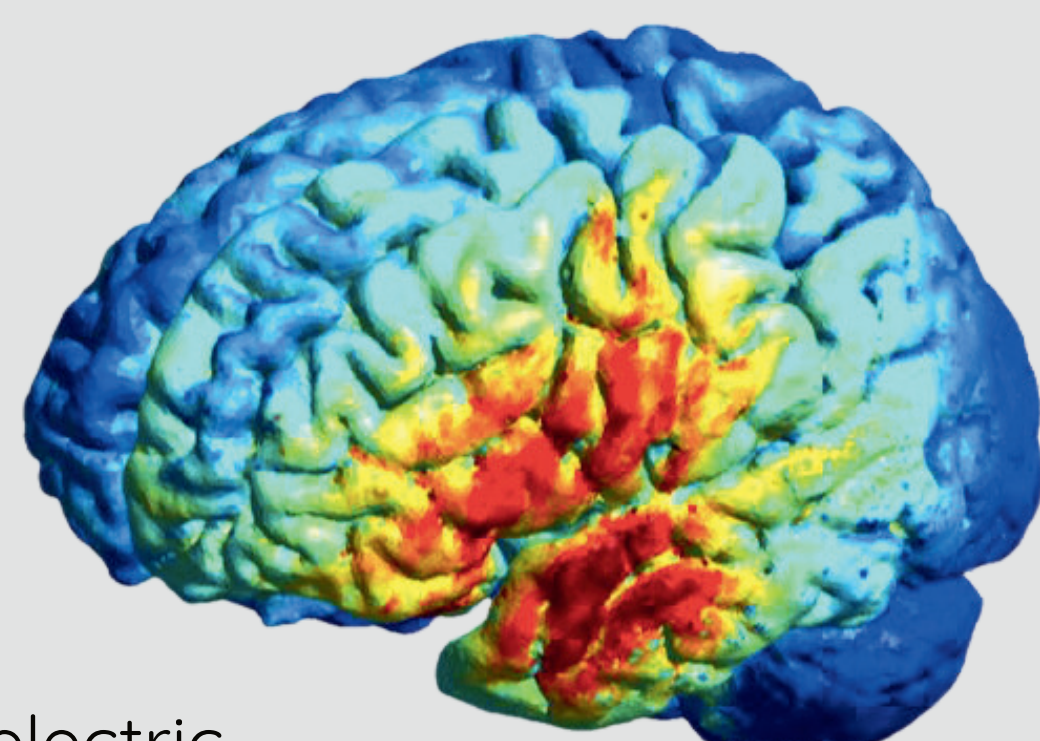
- Auditory verbal hallucinations (AVH) occur in approximately 60% of patients with schizophrenia.
- In more than 30% of patients, this symptom does not respond to treatment with antipsychotics.
- Mechanism of AVH formation not clearly explained - many arguments for the underlying increase in spontaneous neuronal activity in the auditory cortex
- Positive correlation between the presence of positive symptoms (hallucinations and delusions) and higher temporal lobe metabolism in patients with schizophrenia
- The presence of hallucinations correlates positively with resting activation in the anterior cingulate and negatively with the hippocampal area

AIM OF THE STUDY

To verify the following research hypothesis: transcranial direct current stimulation of the left dorsolateral prefrontal cortex (DLPFC) (anode) and left superior temporal gyrus (STG) (cathode) reduces the severity of AVH in patients with schizophrenia and drug-resistant AVH.

Additional objectives of the study:

1. An attempt to use EEG as a method of monitoring the effects of tDCS in AVH
2. An attempt to find electrophysiological biomarkers of tDCS effectiveness in AVH in the EEG record



Distribution of the electric field for tDCS electrode placement used in the study

MATERIALS & METHODS

Forty patients with schizophrenia (diagnosis according to ICD-10 and DSM-V) with treatment-resistant auditory hallucinations will undergo series of treatments consisting of three five-day sessions.

- Each session includes 20 minutes of stimulation.
- The break between sessions should not exceed two days.
- The protocol includes the use of the DC-STIMULATOR PLUS stimulator, current parameters: 2.0 mA, stimulation length 1200 s, ramping in 20 s, ramping out 20 s, number of electrodes 2 (both 5x7cm).
- Location of the anode at point F3 (corresponding to the left DLPFC), location of the cathode at point T3 (corresponding to the left STG). Position placement method according to Beam & Borckardt.
- The study protocol: five tDCS sessions Monday-Friday for 3 consecutive weeks.
- An EEG recording at the beginning and end of each week (six recordings combined).
- Before the treatment and after the 5th, 10th and 15th procedure, severity of AVH assessed with: BAVQ-R (Revised Beliefs About Voices Questionnaire) (Chadwick et al. 2000), Psychotic Symptoms Rating Scale PSYRATS and AVHRS (Auditory Vocal Hallucination Rating Scale) (Jenner & Van de Willige, 2002).

RESULTS

Current research status:

- 14 patients have completed the study protocol
- 208 tDCS procedures performed
- 84 EEG examinations performed
- general clinical improvement observed in majority of patients
- mild or no side effects were observed - statistical analysis regarding the safety of therapy is ongoing
- one patient who underwent the procedure as part of the above study has improved by complete resolution of auditory hallucinations - case report is awaiting publication
- Further results after completing a research study