Noninvasive EEG-EKG guided trans-magnetic stimulation at natural resonance frequency in children with autism: randomized double-blinded pilot study

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Introduction

EEG abnormalities of the neocortex exist in autism spectrum disorder (ASD) when compared with neurotypic EGGs of the same age group (public database 1). Particularly, cortical-to-cortical coherences inherent in normal children may be disrupted in ASD 2. Transmagnetic stimulation (TMS) is a non-invasive modality that may be able to alter baseline EEG patterns, thereby improving cortical connectivity 3. We hypothesize clinical improvement in patients with ASD coinciding with changes in EEG measures.

Low resolution brain electromagnetic tomography (LORETA) of dominant EEG frequencies compared with normative database

LORETA of 11-year old patient with autism demonstrating abnormally high theta distribution throughout the right posterior temporal and bilateral occipital regions (excess is marked in red; Z score >=1.95). LORETA of same patient as (a) now demonstrating deficit of alpha data 1 for same age group. EEG and EKG were used to determine the treatment measures over time with treatment versus sham.

Methods

28 children with moderate to severe ASD were included in a randomized, double-blinded, placebo-controlled clinical trial. In Phase 1, children were divided randomly into treatment versus sham group and treated with EEG-EKG guided transmagnetic stimulation (MeRT) daily for 5 weeks. In Phase 2, all children were blinded, placebo-controlled clinical trial. In Phase 1, children were divided randomly into treatment versus sham group and treated with EEG-EKG guided transmagnetic stimulation (MeRT) daily for 5 weeks. In Phase 2, all children were blinded, placebo-controlled. Subjects’ EEG, QEEG, FFT and symptoms were scored at baseline and every 2 weeks and compared with existing normative database. 10 of 14 patients who received 5 weeks of MeRT showed >5 points CARST2-ST reduction versus 0 of 14 patients who received 5 weeks of sham (p<0.01). After open label, 23 of 28 children showed CARST score reduction > 5 points (82%). In particular, improvements were noted in sensory perception as supported by CARST2-ST. Cortical coherence and phase lag coherences were significantly altered across bands following treatment (p <0.05) when compared to sham. EEG measures showed a shift towards normotypical.

Results

Changes in resting EEG

Coherence Measures Post-5 Weeks MeRT Therapy Sham+Treat

Discussion

Following 5 weeks of EEG-EKG guided transmagnetic stimulation, significant changes in symptom severity and EEG measures are reported for 28 children with autism spectrum disorder. Parents reported most improvements in CARST2 subdomains II “imitation”, III “emotional response,” IV “body use,” VI “adaptation to change” and, IX “taste, smell, and touch responses and use”. This suggests that EEG-EKG guided TMS may be effective at mitigating averse sensory misperceptions common in ASD. Majority of children who improved were of ages slightly less than 7, rather than pre-adolescents. Improvements were noted in a ‘short’ 10 week window and counter to natural ASD developmental trajectories 1. There was also no significant correlation between initial CARST score and amount of CARST reduction. We were able to achieve EEG changes while maintaining output intensity at less than or equal to 80% of motor threshold. Given the low n, however, further studies will be necessary.

References