Medical Advances

Transcranial Electrical Acupuncture Stimulation (TEAS) on the Treatment of Autism

Jing Liu, MD, PhD

[N A J Med Sci. 2009;2(2):67-68.]

Many studies suggested that acupuncture or electrical acupuncture may improve the symptoms of autism. However, the efficacy of the treatment is not satisfied. To improve the existing methodology of acupuncture in treating autism, a concept of transcranial electrical acupuncture stimulation (TEAS) is proposed based on the primary clinical experiences and literature reviews.

The functional magnetic resonance imaging (fMRI) studies suggest that autistic individuals have larger total brain, cerebellar and cudate nucleus volumes but a reduced corpus callosum.[1] These changes could be, at least in part, related to the inflammatory status of the brain.[2] The changes of the neurological activities in the prefrontal and temporal regions may explain many symptoms of autism. For example, fMRI found that the superior temporal sulcus (STS) region is an important component of the network of brain regions that support various aspects of social cognition and social perception.[3] Recent studies further demonstrate that the neuropathology of autism is characterized by a disturbance of cortical modularity. The elemental modular microcircuit of the neocortex is associated with cellular abnormalities of the minicolumn.[4] Minicolumns comprise the cells which release excitatory signals. On the other side, minicolumns are surrounded by GABAergic inhibitory interneurons.[5] Thereby, the balance of excitatory and inhibitory signals maintains the normal neural function. GABAergic inhibitory functions are reduced in autistic individuals, mostly in the prefrontal cortex. [6]The loss of surround GABAergic inhibitory activity may result in the amplification of signals and loss of information processing, which may explain some symptoms of autism, including auditory-tactile hypersensitivity, raised physiological stress and impulsive actions. The excessive signal may lead to hyperexcitable behavior.[7] On the other hand, the superior temporal sulcus function may underlie many of the social and language abnormalities seen in autism [8]. In conclusion, it seems that one of the major targets of autism treatment should be on improving the prefrontal and temporal-limbic region functions, enhancing GABAergic activity and reducing inflammation. Here, acupuncture, particularly electrical acupuncture, is considered a useful treatment for the purpose.

Acupuncture treatment is viewed to modulate the integrations of the mind and the body that are disrupted or impaired. Using BOLD fMRI, we previously demonstrated that acupuncture needle manipulation at classical acupoints elicited modulatory activities in the cortico-limbic-subcortical network in normal human subjects.[9] Many results suggest that acupuncture may down-regulate exaggerated neural activity and generate a tranquilizing effect that is beneficial for the hyperexcitable behavior of autism patients.

It was reported that electrical acupuncture significantly improved the SPECT image of 78.95% of autism and clinical behaviors in a 34 case clinical study, including increased blood flow and enhanced function in the prefrontal cortex, broca and wernicke region.[10] Acupuncture produces milder side effects and significant improvement in anxiety somatization and cognitive disturbance.[11] The response rate and relapse rate were comparable to those of conventional treatments.[12] Interestingly, acupuncture or electrical acupuncture was also found to have anti-inflammatory effects [13] and GABAergic enhancing efficacy.[14]

However, it is also clear that the conventional knowledge and techniques of acupuncture have limited efficacy in the treatment of autism. To improve the result of the treatment, a new approach of transcranial electrical acupuncture (TEAS) is proposed here based on the preliminary studies, and is speculated to achieve better results in treating autism. This hypothesis is supported by the study of transcranial direct current stimulation (tDCS). tDCS involves placing metal electrodes on the scalp by directly applying a small and harmless current across the cranium. The current can hyperpolarize or depolarize neurons in the path of the current depending on the electrode polarity.[15] It was shown that bilateral tDCS over frontal cortex enhanced retention of word pairs learned during the preceding day.[16] A slight change in the resting potential of stimulated cells was observed by applying tDCS of 1 mA. As a result, the information processing was improved through bringing neurons closer to

Jing Liu, MD, PhD
Department of Radiology
Massachusetts General Hospital
Harvard Medical School, Charlestown, MA 02129

depolarization thresholds in response to appropriate inputs, or by strengthening effects on glutamatergic synapses.[17]

Synthesizing these findings together, we have reason to speculate that the TEAS may elicit more reliable effects in improving the disrupted functions of the prefrontal and temporal system in autism. Considering that the prefrontal and temporal gyrus are located in the relative superior areas of the brain, the targeted treatment of the TEAS is easier to be applied, and the effect of such treatment is easier to be measured by using modern techniques such as EEG and fMRI without the interferences from other deeper brain structures.

References

1. Hrdlicka M. Structural neuroimaging in autism. Neuro Endocrinol Lett. 2008;29(3):281-286.
2. Cohly HH, Panja A. Immunological findings in autism. Int Rev Neurobiol. 2005;71:317-341.
3. Pelphrey KA, Carter EJ. Brain mechanisms for social perception: lessons from autism and typical development. Ann N Y Acad Sci. 2008;1145:283-299.
4. Casanova MF, van Kooten IA, Switala AE, et al. Minicolumnar abnormalities in autism. Acta Neuropathol. 2006;112(3):287-303.
5. Casanova MF, Buxhoeveden D, Gomez J. Disruption in the inhibitory architecture of the cell minicolumn: implications for autisim. Neuroscientist. 2003;9(6):496-507.
6. Fatemi SH, Reutiman TJ, Folsom TD, Thuras PD. GABA(A) receptor downregulation in brains of subjects with autism. J Autism Dev Disord. 2009;39(2):223-230.
7. Casanova MF, Buxhoeveden DP, Brown C. Clinical and macroscopic correlates of minicolumnar pathology in autism. J Child Neurol. 2002;17(9):692-695.
8. Redcay E, Courchesne E. Deviant functional magnetic resonance imaging patterns of brain activity to speech in 2-3-year-old children with autism spectrum disorder. Biol Psychiatry. 2008;64(7):589-98.
9. Hui KK, Liu J, Marina O, et al. The integrated response of the human cerebro-cerebellar and limbic systems to acupuncture stimulation at ST 36 as evidenced by fMRI. Neuroimage. 2005;27(3):479-496.
10. Jia SW, Sun TT, Fan R. Visualized study on acupuncture treatment of children autism using single photon emission computed tomography. Zhongguo Zhong Xi Yi Jie He Za Zhi. 2008;28(10):886-889.
11. Röschke J, Wolf C, Müller MJ, et al. The benefit from whole body acupuncture in major depression. J Affect Disord. 2000;57(1-3):73-81.
12. Gallagher SM, Allen JJ, Hitt SK, Schnyer RN, Manber R. Six-month depression relapse rates among women treated with acupuncture. Complement Ther Med. 2001;9(4):216-218.
13. Zijlstra FJ, van den Berg-de Lange I, Huygen FJ, Klein J. Anti-inflammatory actions of acupuncture. Mediators Inflamm. 2003;12(2):59-69.
14. Lee BH, Zhao RJ, Moon JY, et al. Differential involvement of GABA system in mediating behavioral and neurochemical effect of acupuncture in ethanol-withdrawn rats. Neurosci Lett. 2008;443(3):213-217.
15. Fregni F, Boggio PS, Nitsche M, et al. Anodal transcranial direct current stimulation of prefrontal cortex enhances working memory. Exp Brain Res. 2005;166(1):23-30.
16. Monti A, Cogiamanian F, Marceglia S, et al. Improved naming after transcranial direct current stimulation in aphasia. J Neurol Neurosurg Psychiatry. 2008;79(4):451-453.
17. Stagg CJ, Best JG, Stephenson MC, et al. Polarity-sensitive modulation of cortical neurotransmitters by transcranial stimulation. J Neurosci. 2009; 22; 29(16): 5202-5206.