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Note on Neurofeedback of Patients of Insomnia

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Abstract

FMRI (functional magnetic resonance imaging) is meant for measuring the blood oxygenation level based signal in the brain. It is a quantity that comes from various physiological and biophysical sources and denotes to neural activity a vascular coupling. FMRI has particular preference over other neuroimaging non-invasive methods like electroencephalographic recordings (EEG). rtfMRI, (real time fmri) is a process that adopts functional counsel from a MRI scanner where the fMRI keep runs to data acquisition. Currently, rtfMRI is applied to intraoperative surgical guidance, brain–computer interfaces , and neurofeedback. Insomnia is a disorder in sleep that constantly affects several crores of people worldwide. People with insomnia finds it hard to go to asleep or remain asleep. Using rest-state functional connectivity depending on variations in certain regions of interest in brain one can examine connectivity alterations on patients of insomnia.. In this paper, we have reported on the findings of Huan Zhang et al's approach concerning rt-fMRI (real-time functional magnetic resonance neurofeedback) therapy for training for patients of insomnia.

Keywords: Insomnia; Real-time functional magnetic resonance neurofeedback therapy; Mental disorder

Introduction

Insomnia is a disorder in sleep. It can make an affected individual difficult to get into asleep, difficult to remain asleep. It can make you to rise up very early and make you not be able to go back to sleep. The affected person will feel tired when rise up. It not only diminishes the energy level and mood but also the health and quality of life. Sleep requirement varies from one individual to another, but normally for adults seven to eight hours of sleep at night is essential. Every adult individual at some time of his/her life experience short-term insomnia due to stress and it may last for a few days or weeks. But certain individuals experience long-term insomnia that continues for even more than a month. Insomnia can occur as a main problem and in some cases it may be clubbed with medications and other medical conditions. Stress, travel, poor sleep habits, excessive eating in the late evenings are identified as some general causes of chronic insomnia. Also insomnia is common as one gets older and older. Patients of insomnia experience a lot of brain activity before becoming asleep. It can impair cognitive function, and result in mental illness [1,2]. There are two methods to treat insomnia such as pharmacological and non-pharmacological. The former comes with side effects [3] and the latter are effective in providing relief to insomnia symptoms with non-cognitive behavioural therapy, physical exercise, and acupuncture [4,5]. The authors in Zhang H, et al. [6] adopted a novel, new and distinct treatment namely rt-fMRI NF (real-time functional magnetic resonance neurofeedback given in Weiskopf N [7], to nullify the non-positive emotions of

insomnia affected patients through proper regulation of emotions like recalling positive autobiographical memory by feeding back. It activates emotion linked regions in the brains to provide relief to symptoms of insomnia. But, as it is not known which neural mechanisms improved sleep quality it is pertinent to record the physiological changes and functional connectivity in brain to comprehend the outcomes of various methods of treatment for insomnia. One another analysis also demonstrated that an increase in sleep quality can be attributed to more functional connectivity among the default mode network and the prefrontal cortex [8]. The authors in Zhang H, et al. [6] probed the aftermath of connectivity in insomnia due to the application of rt-fMRI neurofeedback procedure at the massive-scale level in network of brain through data-driven techniques to give a new viewpoint for improved comprehension regarding rt-fMRI neurofeedback. They in-fact hypothesized it.

Procedure Adopted by Huan Zhang, et al.

The authors in Zhang H, et al. [6] have conducted an experimental research on 24 patients diagnosed for insomnia. Their average age was 47.13 years with a standard deviation of 12.76 years and out of them 5 are males and 19 are females. All of them were examined as per the criteria spelled by DSM (Diagnostic and Statistical Manual of Mental Disorders). It was observed that they exhibited symptoms like difficulty to get into asleep, early rise and hyper arousal phenomena. PSQI (Pittsburgh Sleep Quality Index) score of all of them was found to be more than 7 and the ISI (Insomnia Severity Index) value was more than 8. They were not administered to any medication for sleep-improvement during the period of their experimentation.

The paradigm followed during their experimentation was 6 visits in their observation period. The gap between two consecutive period of visits were set as one week. The selected individuals were asked to complete the form for emotion and sleep in week 1 and an overnight PSG (Polysomnography) test measurement was recorded. In second week their T1 (structural image), T2 (the weighted image) resting state of the individuals were scanned. In weeks 3 to 5, neurofeedback sessions were recorded. Further, the state of their rest before and after neurofeedback training were also scanned. The individuals were asked give their concentrate and look score at the cross in the screen. During week 6 they acquired the T1 structural image and T2-weighted image and resting state.

The authors acquired data of fMRI data through the 64- channel head coil on a 3T Siemens Prisma and collected the T1-weighted anatomical images on high-resolution. Then they collected the functional images through an EPI sequence (echo-planar imaging). They processed the data of fMRI and adopted the data of rest-state during the week 3 and week 6 visits to analyze the mechanism of brain imaging for improvement of sleep. For data pre-processing they involved the toolbox of Gretna [9]. They then got the brain network of rest-state. They determined the number of components of rest-data with the help of MDL principle (minimum description length) [10]. Then they applied infomax step by step procedure on data of fMRI for decomposing it and converted every stand-alone component into z-values through the procedure of normalization. The ROI (regions of interest) in brain networks were chosen with the help of the highest spatial correlation. They also used the template for brain network to probe the components under spatial template and picked networks of interest. As a master stroke the Karl Pearson correlations among time courses of networks were determined. They also applied Fisher-Z transformation on coefficients due to correlation and found the variations in connectivity patterns that are functional among brain networks once before and once after neurofeedback were tested by involving paired T-test.

Some Observations on the Analysis of Huan Zhang, et al.

The authors probed in Zhang H, et al. [6] the rest state functional connectivity of brain functional networks in insomnia affected patients after performing rt-fMRI neurofeedback. It was observed the decrease of LECN (left executive control network), aSAN (anterior salience network) and LECN-dDMN (dorsal default mode network) functional connectivity and increase of dDMN-pSAN (posterior salience network) functional connectivity in comparison with before NF (neurofeedback). The early probes show that poor sleep is attributed to responses that are abnormal to emotions regions of interest in brain. This counsel demonstrates that patients of insomnia are getting their memories ruminated and this helps to get into sleep. Also, the SAN is the main cause of attention provide and control processing. It is found that when patients of insomnia are exposed to negative vibration, the SAN controls the ECN to improve cooperation inside and activates the DMN to diminish resource exhaust inside, and betters the patient's difficulty in processing against negative vibration.

Conclusion

The functional connectivity among networks of brain reveals that variations among control networks that are cognitive and networks that are emotional-linked are affected with betterments in insomnia after rt-fMRI neurofeedback training in patients of insomnia. These variations may be an indicator for biological marker in neurofeedback training to patients of insomnia and may result in favor of rt-fMRI neurofeedback procedure.

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