Erciyes Med J 2018; 40(4): 175-6 • DOI: 10.5152/etd.2018.18133

EDITORIAL COMMENTS

Does the Brain Work While Resting? Resting State fMRI

Niyazi Acer

Since the beginning of time, humankind has wondered about what happens in the brain. The human brain works even while relaxing or at rest (1). Functional magnetic resonance imaging (fMRI) has rapidly grown and has got applications in a wide variety of fields such as neuroscience, psychology, clinic medicine, and political science in the past several years.

Functional magnetic resonance imaging (fMRI) is rooted in oxygenated and deoxygenated hemoglobin for paramagnetic properties to show images of changing blood flow in the brain linked with neural activity (2). During the performance of different tasks or at resting state, it offers the generation of images that reflect the activated brain structures (3). fMRI is an increasingly gaining popularity because of being a noninvasive technique for brain functions such as emotion, memory, language, etc. (1).

Since the invention of fMRI, studies on resting-state fMRI (rs-fMRI) have become widespread in the past two decades. rs-fMRI allows the mapping of regional interactions in the brain at resting state in other words when an explicit task is not being performed (4, 5).

Ogawa et al (6) was the first person to demonstrate the potential importance of blood oxygenation level-dependent (BOLD) contrast. Task-based fMRI and rs-fMRI use BOLD contrast. Rs-fMRI display spontaneous low-frequency oscillations arising from spatiotemporal correlations, continuously communicating functionally linked networks of anatomical regions (1). Biswal proposed seed-based analysis in which a seed is selected and the linear correlation of this seed region with all the other voxels in the entire brain is found to get the seed-based functional connectivity (FC) map (1). Spontaneous low-frequency fluctuations are resting-state signals in the range of 0.01-0.08 Hz. When resting state fMRI scan is obtained, volunteers are instructed to relax and not to think of anything in particular during these experiments (7). rs-fMRI protocol can be applied in the following three ways: eyes open, eyes closed, and eyes open while focusing on a dash bar on the screen. The subjects must not fall asleep during the eyes-closed protocol (7). In literature, most studies were performed on a 1.5 T or 3 T MR scanners. During a resting-state fMRI scan, both structural imaging and gradient-echo echo-planar imaging T2* weighted sequences are taken to measure to brain activity (8). A time series of 3D images is collected for fMRI data.

Brain connectivity is divided into the following two general networks: anatomical connectivity (FC) and functional connectivity. (7). Functional connectivity analysis techniques comprise independent component analysis (ICA) and seed-based and graph theory analyses. ICA yields rs-fMRI networks by deriving spatially and temporally independent components from whole brain voxels. ICA examines multiple simultaneous voxel-to-voxel interactions of distinct networks in the brain (1). Using these methods, some common neurologic and psychiatric brain disorders including schizophrenia (9), attention deficit hyperactivity disorder, Alzheimer's disease (AD) (10), depression (11), Parkinson disease (PD), and multiple sclerosis (12) were studied. Default mode functional connectivity were decreased in AD (10). According to van den Heuvel, a decrease was found between medial frontal cortex and precuneus in schizophrenic patients using default mode functional connectivity analysis. (7). In the early stage of Parkinsonism, the overall organization of the brain network was disrupted, which decreased global efficiency and disconnected modularity and hub distribution (13).

For rs-fMRI analyses, software such as statistical parametric map (SPM), REST, FSL, CONN are used for pre and post-processing analysis (1). For analysis, head motion correction is done, the functional images are co-registered to structural images using a six-parameter rigid-body transformation and a 12-parameter affine transformation (8). The preprocessing steps include slice timing, realignment to correct head motion, co-registration to anatomical images, and normalization to a standard template. After these processes, the images are smoothed (8). A general

Cite this article as:
Acer N. Does the Brain Work While Resting? Resting State fMRI. Erciyes Med J 2018; 40(4): 175-6.

Department of Anatomy, Erciyes University Faculty of Medicine, Kayseri, Turkey

Submitted
25.09.2018

Accepted
26.09.2018

Available Online Date
19.11.2018

Correspondence
Niyazi Acer, Department of Anatomy, Erciyes University Faculty of Medicine, Kayseri, Turkey
Phone: 0352207666
e.mail: acerniyazi@gmail.com

linear model (GLM) is commonly used for statistical assumptions of brain activation maps that convert a voxel time series into a space defined in the design matrix spanned by a set of basis vectors (3).

There are the different networks in the brain: the default mode, auditory, salience, visuospatial, executive, language, precuneus, primary visual, sensory motor networks, etc. (1). The most commonly used is the default mode network which involves the medial prefrontal cortex and the posterior cingulate cortex and lateral parietal cortex. The default mode network performs only when the individual is in the resting state (1).

Resting-state fMRI (rs-fMRI) may be used in the diagnosis and prognosis of certain brain diseases affecting brain activity, thereby offering a promising option in the treatment in the resting state using brain connectivity analysis. rs-fMRI may provide important information to be used for many potential clinical applications as well as fundamental cognitive neuroscience investigations. We can understand the mechanisms underlying human brain function using rs-fMRI.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author has no conflicts of interest to declare.

Financial Disclosure: This work is funded by the BAP of Erciyes University (TIR-2017-5045).

REFERENCES

1. Smitha KA, Akhil Raja K, Arun KM, Rajesh PG, Thomas B, Kapilamoorthy TR, et al. Resting state fMRI: A review on methods in resting state connectivity analysis and resting state networks. Neuroradiol J 2017; 30(4): 305-17. [CrossRef]
2. Lanni C, Lenzken SC, Pascale A, Del Vecchio I, Racchi M, Pistoia F, Govoni S. Cognition enhancers between treating and doping the mind. Pharmacol Res 2008; 57(3): 196-213. [CrossRef]
3. Glover GH. Overview of functional magnetic resonance imaging. Neurosurg Clin N Am 2011; 22(2): 133-9. [CrossRef]
4. Lee MH, Hacker CD, Snyder AZ, Corbetta M, Zhang D, Leuthardt EC, et al. Clustering of Resting State Networks. PLoS ONE 2012; 7(7): doi:10.1371/ journal.pone.0040370
5. Buckner RL, Krienen FM, Yeo BT. Opportunities and limitations of intrinsic functional connectivity MRI. Nat Neurosci 2013; 16(7): 832-7. [CrossRef]
6. Ogawa S, Menon RS, Kim SG, Ugurbil K. On the characteristics of functional magnetic resonance imaging of the brain. Annu Rev Biophys Biomol Struct 1998; 27: 447-74. [CrossRef]
7. van den Heuvel MP, Hulshoff Pol HE. Exploring the brain network: a review on resting-state fMRI functional connectivity. Eur Neuropsychopharmacol 2010; 20(8): 519-34. [CrossRef]
8. Gultekin M, Bayramov R, Karaca C, Acer N. Sialidosis type I presenting with a novel mutation and advanced neuroimaging features. Neurosciences (Riyadh) 2018; 23(1): 57-61. [CrossRef]
9. Rotarska-Jagiela A, van de Ven V, Oertel-Knöchel V, Uhlhaas PJ, Vogeley K, Linden DE. Resting-state functional network correlates of psychotic symptoms in schizophrenia. Schizophr Res 2010; 117(1): 21-30. [CrossRef]
10. Greicius MD, Krasnow B, Reiss AL, Menon V. Menon Functional connectivity in the resting brain: a network analysis of the default mode hypothesis. Proc Natl Acad Sci 2003; 100(1): 253-8. [CrossRef]
11. Greicius MD, Flores BH, Menon V, Glover GH, Solvason HB, Kenna H, et al. Resting-state functional connectivity in major depression: abnormally increased contributions from subgenual cingulate cortex and thalamus. Biol Psychiatry 2007; 62: 429-37. [CrossRef]
12. Lowe MJ, Beall EB, Sakaie KE, Koenig KA, Stone L, Marrie RA, et al. Resting state sensorimotor functional connectivity in multiple sclerosis inversely correlates with transcallosal motor pathway transverse diffusivity. Hum Brain Mapp 2008; 29(7): 818-27. [CrossRef]
13. Sang L, Zhang J, Wang L, Zhang J, Zhang Y, Li P, et al. Alteration of brain functional networks in early-stage Parkinson's disease: a resting-state fMRI study. PLoS One 2015; doi: 10.1371/journal.pone.0141815. eCollection 2015. [CrossRef]