

A Review of MEG in Parkinson's Disease

M. Bhuvaneswari

Asst Prof, Dept of ECE, Karpagam Academy of Higher Education, India
bhuvaneshwari.m@kahedu.edu.in

Article Info

Volume 83

Page Number: 2338 - 2341

Publication Issue:

March - April 2020

Article History

Article Received: 24 July 2019

Revised: 12 September 2019

Accepted: 15 February 2020

Publication: 19 March 2020

Abstract:

Parkinson's disease (PD) one of the movement disorder which occur in the neurological activities, but the diagnosis of disease is quite challenging. Sometimes the diagnosis methods are difficult at the time of considering a large number of motor and non-motor symptoms in PD patients. But it is highly risk to manage a PD patients in medical management. To enhance that lot of research are focused on PD for long term approaches. Further this paper contributes the reviews of Parkinson's disease and its treatment. Also it concluded with different ideas and limited drugs for continuous treatment.

Keywords: Parkinson diseases, MEG signal and Magnetic source imaging.

I. Introduction

Magneto encephalography (MEG) is a non-invasive technique which is used to measure the neural activity of brain by recording the magnetic fields generated by electrical current. The MEG is combined with MRI to get an accurate structural perspective and resolution of neuronal activity. This combination is called as magnetic source imaging (MSI). The magnetic field used in magneto encephalography is to measure the brain which is in the range of femto –tesla to pico –tesla. The Parkinson's disease (PD) is a growing neurological disorder which cause serious disability and reduce the quality of life [1]. The features of cardinal motor and the response to the dopaminergic therapy are the characteristic signs of PD. The neuro physiological characters related to Parkinson's disease (PD) are studied within the motor system and the whole brain using magneto encephalography. The accuracy of clinical diagnosis is around 80 to 90 % [2]. In the analyses of MEG the aim of motor networks are spatially limited to the motor cortex which is performed usually in source space. MEG helps to investigate the underlying mechanisms of

hallucinations in PD patients. The frequency-specific neural oscillations in PD patients are studied using MEG with unimodel Visual Hallucination (VH) and compared with multimodel hallucination and without hallucination PD patients. The MEG data of PD patients are recorded using 306 channels (102 magnetometers, 204 gradiometers) with the sample frequency range of 1250Hz [3]. The origin of MEG signals are shown in fig 1 which representing the depolarisation of intracellular and extracellular currents. From figure 1, origins of the MEG signals are visualized and coronal section and communication between depolarization and polarisation can be understood.

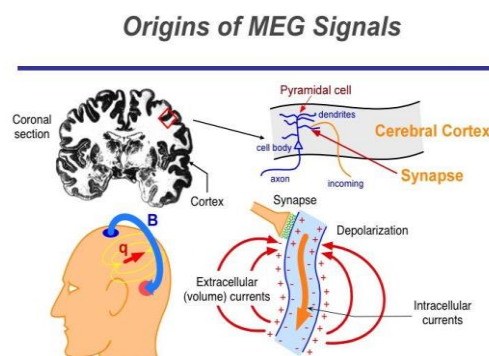


Fig.1 MEG potentials

II. Literature Review

Abbasi et.al [4], proposes the measures of spectral analysis in unilateral DBS in (both 130 Hz and 340 Hz) that leads to a lowering of alpha and beta power over both sensorimotor cortices. These recordings took place the day after surgery with eyes closed and motor improvement was found without correlation. Luoma et.al[5], assigns the alpha lowering and beta band power during DBS ON, only during the resting state when the eyes were open. During eyes-closed or a motor task: No significant difference between ON and OFF stimulation. -Maximum CMC over sensorimotor area contralateral to extended hand.

Airaksinen et.al[6], suggests the STN-DBS modified the coherence of CMC with large inter individual variability, correlation with motor improvement was inconsistent. Hall et.al[7], shows the contralateral M1 with resting-state beta power than ipsilateral M1 in PD. zolpidem normalized the ratio between left and right. Normalization correlated positively with improvement in UPDRS-III scores. M1 beta power differences during different phases of movement (a.o. PMBR), normalized after zolpidem.

Hirschmann et.al[8], cortical sources coherent with oscillations STN in PD DBS patients in the age of 11 to 26. It consists of two bands alpha band and beta band. In Alpha band Ipsilateral temporal regions are located, in beta band Ipsilateral sensor motor and adjacent premotor cortex are located. HeinrichsGraham et.al[9], proposes the PD (DRT OFF) vs controls with the help of spectral analysis significantly at lower beta band power in bilateral motor regions. After DRT, this largely normalizes. The FC Increased synchronicity between motor and cortices are partially normalized by DRT. HeinrichsGraham et.al[10], suggests the amplitudes response which affects severely to the PD patients suffering from right-dominant disease. [15-18]

Jha et.al [11], contributes the coherence between alpha and beta band at the age of 9 to 25. In Alpha band coherence between the PPN and posterior brain stem and cingulum. In Beta band coherence between PPN and medial frontal wall, SMA and primary motor cortex. Krause et al[12] , proposes the tACS of the motor cortex at beta frequency (20 Hz), but not at 10 Hz, attenuated beta band CMC during isometric contraction and reduced performance (amplitude variability) of a finger tapping task in PD, but not in controls. Further the performance of PD patients controls on motor task (motor sequence acquisition). During random presentation of the task there are no differences in beta band power. After learning a sequence the less training-related beta power suppression in motor cortex in PD versus HC. In addition, less training related theta activity in cortical motor regions, paralleling susceptibility to inference [13].

Oswal et.al[14] , describe the Alpha band coherence between temporal cortical areas and the STN reduced following movement onset. The degree of suppression in is significantly greater ON DRT than OFF DRT. Oswal et.al [15], the DBS relatively selectively suppressed lower beta band synchronization of activity between STN and mesial premotor regions, including SMA. Then the motor cortical regions “driving” STN in beta band with different delays for lower and higher beta band. TeWoerd et.al, suggest PD patients have demonstrated comparable auditory entrainment as controls. Therefore the deficient entrainment in PD patients concerns the motor circuits only. MEG signals reflects the alpha band coherence for the PD patients and there is positive correlation between the MEG signal and auditory evoked potential signal. [17-20]

III. Conclusion

Parkinson's disease (PD) one of the movement disorder which occur in the neurological activities, but the diagnosis of disease is quite

challenging. The neuro physiological characters related to Parkinson's disease (PD) are studied within the motor system and the whole brain using magneto encephalography. However, this paper represents the review on Parkinson's disease using MEG signal and some of the challenging reviews also concluded.

REFERENCE

- [1]. Gómez, Carlos, Dubbelink, Kim, Stam, Cornelis, Abásolo, Daniel, Berendse, Henk, Hornero, Roberto, Complexity Analysis of Resting-State MEG Activity in Early-Stage Parkinson's Disease Patients, *Annals of biomedical engineering*, Vol.39, 2011.
- [2]. Sanjay P Singh, 'Magnetoencephalography: Basic Principles', 2014.
- [3]. Victor J Geraedts, Arjan Hillebrand, 'A systematic review of MEG-based studies in Parkinson's disease: The motor system and beyond', 2019.
- [4]. M Dauwan, E M Vriens, 'Aberrant resting-state oscillatory brain activity in Parkinson's disease patients with visual hallucinations: An MEG source-space study', 2019.
- [5]. Jarkko Luomaa, Eero Pekkonen, 'Spontaneous sensorimotor cortical activity is suppressed by deep brain stimulation in patients with advanced Parkinson's disease', 2018.
- [6]. Katja Airaksinen, Jyrki P Mäkelä, 'Cortico-muscular coherence in advanced Parkinson's disease with deep brain stimulation', 2014.
- [7]. Emma L. Hall, Siân E. Robson, Peter G. Morris, 'the Relationship between MEG and MRI: A Review Article for the Special Issue of NeuroImage on Multi-Modal Data Fusion', 2014.
- [8]. Hirschmann J, Ozkurt TE, 'Distinct oscillatory STN-cortical loops revealed by simultaneous MEG and local field potential recordings in patients with Parkinson's disease', 2011.
- [9]. Elizabeth Heinrichs Graham, Max J Kurz, 'Hypersynchrony despite pathologically reduced beta oscillations in patients with parkinson's disease: a pharmaco Magnetoencephalography study', 2014.
- [10]. Elizabeth Heinrichs Graham, Pamela M Santamaria, 'The cortical signature of symptom laterality in Parkinson's disease', 2017.
- [11]. Ashwani Jha, Vladimir Litvak, 'Functional Connectivity of the Pedunculopontine Nucleus and Surrounding region in Parkinson's Disease', Vol.27, 2017.
- [12]. Vanessa Krause, Claudia Wach, 'Cortico muscular coupling and motor performance are modulated by 20 Hz transcranial alternating current stimulation (tACS) in Parkinson's disease', 2013.
- [13]. Sarah Nadine Meissner, Vanessa Krause, 'the significance of brain oscillation in motor sequence learning: Insights from Parkinson's disease', 2018.
- [14]. Ashwini Oswal, Peter Brown, 'Synchronized neural oscillations and the pathophysiology of Parkinson's disease', 2013.
- [15]. Ashwini Oswal, Martijn Beudel, 'Deep brain stimulation modulates synchrony within spatially and spectrally distinct resting state networks in Parkinson's disease', Vol.139, 2016.
- [16]. Revathi, P., & Hemalatha, M. (2012, December). Classification of cotton leaf spot diseases using image processing edge detection techniques. In *2012 International Conference on Emerging Trends in Science, Engineering and Technology (INCOSSET)* (pp. 169-173). IEEE.
- [17]. Perumal, P. C., Sowmya, S., Pratibha, P., Vidya, B., Anusooriya, P., Starlin, T., ... & Gopalakrishnan, V. K. (2014). Identification of novel PPAR γ agonist from GC-MS analysis of ethanolic extract of *Cayratia trifolia* (L.): a computational molecular

- simulation studies. J App Pharm Sci, 4, 006-011.
- [18]. Suganya, S., Narmadha, R., Gopalakrishnan, V. K., & Devaki, K. (2012). Hypoglycemic effect of *Costus pictus* D. Don on alloxan induced type 2 diabetes mellitus in albino rats. Asian Pacific Journal of Tropical Disease, 2(2), 117-123.
- [19]. Kumar, R. S., Ali, M. A., Osman, H., Ismail, R., Choon, T. S., Yoon, Y. K., ... & Manogaran, E. (2011). Synthesis and discovery of novel hexacyclic cage compounds as inhibitors of acetylcholinesterase. Bioorganic & medicinal chemistry letters, 21(13), 3997-4000.
- [20]. Kalaiselvi, C., & Nasira, G. M. (2015). Prediction of heart diseases and cancer in diabetic patients using data mining techniques. Indian Journal of Science and Technology, 8(14), 1.