RELATIONSHIP BETWEEN MIGRAINE AND EEG: A REVIEW

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Abstract: Any disturbance to the nervous system, per se, leads to the development of neurological disorder. Migraine is one such type of neurological problem. This type of headache is typically marked by throbbing pain that decapitates a person of regular activities. Researchers have tried their hands to study and diagnose this condition through different aids. One such attempt is to detect migraine and study it is using EEG. There are several ways one can analyze an EEG signal. A physician can look at an EEG and identify the differences between normal and abnormal brain activity. This paper is an attempt to investigate a number of ways to analyze EEG signals for the diagnosis or detection of migraine.

Index Terms - **Diagnosis, Electroencephalography analysis, Migraine, Nervous system, Neurological disorder.**

I. INTRODUCTION

The human body can be called a system that is formed by sub-systems. One such subsystem is the nervous system. All these subsystems work in coordination with each other for the smooth functioning of the human body. Neurological disorders are issues of the nervous system. A huge number of individuals overall are influenced by neurological issues [1]. Migraine is a neurovascular ailment, which causes episodes of serious torment and autonomic nervous system aggravation. The clinical examination of Electroencephalogram signals helps in the executives and prognosis of migraine ailment [2]. The predominance of migraine is over 10% around the world [1]. It is far-reaching in the population with duration fluctuating from an uncommon disturbance to a week by week experience [3]. Although the diagnosis of migraine remains a challenge till date, studies show that electroencephalography can successfully detect the abnormalities in the brain during episodes of migraine attacks. The electric current created by a typical human brain is a couple of microvolts, in terms of amplitude. The unconstrained action of the brain is watched for around 20-40 minutes. This results in the age of the EEG signals. The EEG signals are essentially recorded by putting electrodes on the scalp of the subject [4]. A successful course of diagnosis leads to the discovery of a better treatment plan. In this paper, various ways in which EEG can be used for the diagnosis of migraine, as well as the study of it, has been discussed.

II. THE NERVOUS SYSTEM

One can say that the human body is like a house. And there are several rooms in the house known as the organ systems. These rooms (organ systems) are further made of interconnected walls of the rooms like the walls of the organs in the human body. Just like each wall is important to form a room and each room is important for the formation of a house, each organ and organ system is necessary for the formation of the human body as a whole. One such organ system is known as the nervous system. It comprises our brain, spinal cord, and millions of nerves.

The nervous system as a whole is responsible for sending electrical impulses and chemical variations across the body for the purpose of communication. The brain is an extremely complex organ devouring roughly 15% of cardiac yield and can just endure a couple of moments denied oxygen. The spinal cord is made of a combination of bones and is a rough cylinder by shape, all together. There are 31 sets of spinal roots with their relating dorsal and ventral roots to frame a solitary spinal nerve, which at that point separates into a dorsal and ventral ramus [5].

2.1. Neurological Disorders

Any disturbance to the nervous system, per se, leads to the development of neurological disorder. According to the World Health Organization (WHO), the most common neurological disorders are dementia, headache, epilepsy, stroke, etc [5].

2.2. Migraine

Talking in terms of headache, one can say headaches can be either primary or secondary. Migraine is one such primary type of headache. Migraine is generally most disabling to individuals of 35–45 years, yet it can inconvenience a lot of more youthful individuals, including children. Typically beginning at puberty, migraine is recurrent all through life much of the time. Migraine is known to be genetic and it is known to be triggered by a lot of environmental factors. Though the root cause behind this peculiar condition remains unknown, the mechanism of what an individual goes through during a migraine attack can be described as activation of a component somewhere down in the brain causes arrival of agony delivering inflammatory substances around the nerves and blood vessels of the head [6].

III. Migraine and Electroencephalography

K. Jindal et al; published their work on a way to diagnose migraine using a non-linear approach of EEG analysis. The proposed procedure for illness analysis is acted in four phases. In the first stage, the EEG action is enlisted from two separate gatherings of individuals (healthy and migraine pathological conditions). Further, the EEG is pre-processed against artifacts to wipe out non-cerebral wellsprings of electrical records in the subsequent stage. In the third stage, three nonlinear features viz. Permutation Entropy (PE), Katz's Fractal Dimension (FD), and Higuchi's FD are determined from prepared EEG information and the related highlight vector is arranged. The readied include vector is given as a contribution to three AI classifiers viz. Bolster Vector Machine (SVM), Artificial Neural Network (ANN) and Arbitrary Forest (RF) for preparation and approval reasons, in the fourth stage. It was seen that feature extraction successfully diagnoses migraine. And PE was the most efficient feature for the purpose of diagnosis of the interested condition [2].

The time-frequency approach can be considered for the detection of migraine. Migraine often is related to photophobia and audio irritation during a migraine attack. In a study conducted by Zulkamain Md. Amin, EEGs of patients who suffer from migraine and healthy individuals were recorded using external photo-stimulus. The signals were then pre-processed to clean them from any sort of non-cerebral contamination. The study suggested that time-frequency analysis could be performed for the diagnosis of migraine better than any other approach considering the non-stationary nature of EEG signals, thus, techniques such as Fourier transform are totally unsuited for diagnosis of migraine using EEG signals. Short-time Fourier Transform was applied in this study for the detection of migraine. And the spectrogram was enumerated using the Hamming window for the same. It was observed from the spectrogram that migraine patients showed a high response to photo stimulus even with eyes closed, justifying the nature of the disorder. Time-frequency tools are hence powerful means of migraine detection [7].

The pathology of migraine is usually studied using evoked response potential (ERP), which is a sort of neural recording captured during the act of an external stimulus. R. Bellotti et al, tried studying it using spontaneous EEG. The study was conducted between migraine sufferers and a controlled group. The method was carried out using multiresolution wavelet analysis and neural networks. The first step was to analyse wavelet-based features: scale-dependent (SD) and scale-independent (SI). The second step involved the classification of multichannel data using a neural network. The results to study migraine pathology using continuous EEG turned out to be quite disputed. The study concludes that discrimination of EEG of healthy people and the headache-free period of the migraine patients can be done successfully. However, no striking feature was observed in the EEG signals of the migraine patients during the phase of headache (migraine attack). This shows that the EEG of those who suffer from migraine have a perpetual change (in their spontaneous EEG) [3].

Many literature studies claim that migraine diagnosis is possible using neural signals known as electroencephalography (EEG). There is another type of primary headache known as tension-type headache (TTH) which strikingly resembles the characteristics of migraine. A study of Çi_dem Gülüzar Alt_ntop et al, proves that EEG cannot be used to differentiate between TTH and migraine. This suggests the importance of other parameters one should consider for the diagnosis of migraine. The most significant factor in the diagnosis of migraine is cautiousness to the patient's depiction of his/her grumblings. Contingent upon these components, the clinical history of the patient, the age at the beginning, area, attributes, going with side effects, and neurological brokenness of the torment are immeasurably significant for the diagnosis [8].

IV. Discussion

The nervous system comprises the brain, spine, and many nerves. Each of these parts play a huge role in the smooth functioning of the body. Any disorder or issue in the nervous system may be defined as a neurological disorder. It may be as minor as a mild headache to a major stroke.

Migraine is that severe kind of headache which compels the concerned person to shun the corresponding day to day activities. Migraine is known to affect more women than men. It can affect individuals from any age group. It is a peculiar condition as the root cause behind it is still unknown. There is no tool that is designed to diagnose migraine. A migraine attack can last for hours. It is usually accompanied by nausea, extreme sensitivity to light, sensitivity to sound, hallucinations, etc. This neurological disorder is known for interfering with day to day activities. A migraine attack can force a person to get to bed leaving behind the most important activities. The peculiarity of the disease lies behind the fact that the root cause of migraine is not known till date. There are a few factors that trigger these migraine attacks such as alcohol, sound, weather, medications, stress, or even emotional extremities.

Researchers have tried their hands to study and diagnose this condition through different aids. One such attempt is to detect migraine and study it using EEG. There are several ways one can analyse an EEG signal. Techniques such as Fourier transform are totally not recommended for analysis of EEG for migraine detection keeping the non-stationary nature of the neural signals in mind. Time-frequency analysis has been established as a strong aid for the purpose of detection of migraine with inspection of spectrogram. Also, a non-linear approach can be employed to successfully detect migraine. There have also been studies conducted to study EEG of migraine patients using mathematical analysis techniques.

TTH and migraine cannot be differentiated using analysis of EEG. To make sure that diagnosis is done accurately, one must make sure to understand the description of the headache and the history of the patient seriously.

V. CONCLUSION

To proceed with the treatments and relief plans, one must first be diagnosed with a problem. Migraine, however, does not have a test for the diagnosis. A doctor usually observes the type of headache and symptoms along with enquiring about the family history of migraine to conclude that a person has migraine. Tests such as MRI and CT scan are prescribed to ensure or rule out other causes of headaches. The other type of headache that is very commonly observed is the tension type headache. And the people suffering from tension type headache usually show symptoms like that of migraine. Hence, this leads to confusion to differentiate between the two. The human brain sends and receives information by the means of electrical impulses. An electroencephalogram (EEG) is a wave that captures these electrical impulses. It has been observed that migraine and tension type headache can be successfully separated by performing an EEG. A physician can look at an EEG and identify the differences between normal and abnormal brain activity. It has been proven that EEG analysis can be used for the detection and study of migraine by a certain number of studies.

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