

The frequency of abnormal electroencephalography for detecting acute ischemic stroke

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ABSTRACT

Introduction. Cerebrovascular accident is defined as rapidly developing symptoms or signs of focal and global loss of cerebral function lasting for 24 hours or more with no apparent cause other than that of vascular origin. Stroke is the fifth leading cause of death in the United States and it is one of the most disabling cause of neurological disorders. The attack of cerebrovascular accident begins abruptly, the focal neurologic deficit either fully evolved at the onset or it progress over minutes to hours or within days. Electroencephalogram (EEG) is used to detect electrical activity in the brain for various neurologic disorders like epilepsy, encephalopathy, prion diseases (CJD), Alzheimer disease and also stroke.

Objective. To determine the frequency of abnormal EEG for detecting acute ischemic stroke.

Methods. This was a cross sectional study conducted at Department of Medicine, Dow University of Health Sciences Karachi OJHA Campus, Dow International Medical College (DIMC), and Duration of study was 06 month from 1st October 2020 to 30th March 2021. Non-probability consecutive sampling technique was used.

A total of 460 patients of acute ischemic stroke were included in this study. Patients were diagnosed on the basis of CT scan brain or diffusion weighted imaging. Within 24 hours the EEG was done in all admitted patients. The potentials recorded by EEG were cumulated excitatory and inhibitory postsynaptic potentials in neuronal dendrites, usually in most superficial regions of cerebral cortex. All data was entered and analyzed using SPSS v25.0. Data were stratified for age, gender, BMI and duration of stroke to address the effect modifiers. Post-stratification, Chi-square test was used by taking p-value ≤ 0.05 as significant.

Results. 460 patients were selected for this study. Mean age was 40.04 ± 9.1 years. Among cases, there were 276 (60%) males and 184 (40%) females. 235 patients (51.08%) had abnormal EEG. By stratification of abnormal EEG, it was found that duration of acute stroke had significant effect having abnormal EEG ($p = 0.000001$).

Conclusions. The role of complexity of abnormal Electro Encephalogram is useful following acute ischemic stroke. The various parameters of EEG help to evaluate the large ischemic stroke.

Keywords: acute cerebrovascular accident, electroencephalogram

INTRODUCTION

Cerebrovascular accident or stroke is defined as rapidly evolution of symptoms or signs of focal and global cerebral dysfunction lasting for 24 hours or more with no obvious cause other than that of vascular origin [1]. In eighty-five percent of case ischemic stroke occurs and is due to decrease blood flow in the vessels supplying the brain. In fifteen percent cases hemorrhagic stroke occurs due to rupture of an artery [2]. Stroke is one of the most

common disabling neurologic disorder, it is the fifth most common cause of death in the U.S after heart disease, cancer, and chronic lung disease and road accidents [3]. The incidence of stroke varies among different population. In Pakistan the incidence of stroke is 250 per one lac population (350,000 new stroke patients every year) in this country [4]. Hypertension and hyperlipidemia are the most common risk factors and large vessel atherosclerosis is the most common stroke etiology in Pakistan as reported in one of the case study. Old age patients are

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more prone to develop in-hospital complications and die during their hospital stay [5]. There are different mechanisms of stroke in young adults as related to mechanisms found in older individuals. Artherosclerosis, cardio-embolism, anemia, fibro muscular dysplasia, and pregnancy related angiopathy, migraines arteriopathy, antiphospholipid syndrome (APLA), connective tissue disorders, arterial dissection, arterio-venous malformations, smoking, toxic substances and head injuries have been described [6].

Electroencephalography (EEG) is used to detect various neurological disorders like epilepsy, encephalopathy, and autoimmune encephalitis, Prion disease (CJD), Alzheimer's disease, cerebral dysfunctions and other degenerative disorders [7]. The patients with cerebrovascular accident present with the characteristic rhythmic abnormalities on EEG. The quantitative EEG is a new technique (QEEG) in evaluating pathophysiology and monitoring of patients following acute ischemic stroke, the θ/β ratio increased in the affected cerebral hemisphere [8].

The electroencephalogram and quantitative EEG can be used to monitor treatment responses after reperfusion therapy [9]. The QEEG can also detect lack of significant response to reperfusion therapy, (e.g. tissue plasminogen alteplase) and help quick decisions for neuro interventions [10].

In acute ischemic stroke the EEG showed background slowing, and sharp and slow wave discharges which are consistent with the infarct location. These abnormal electrical discharges are mostly recorded unilaterally around the infarct [11]. The study on one sixty two cases of acute ischemic stroke, 53% patients found to have abnormal EEG [12].

OBJECTIVE

To determine the frequency of abnormal EEG for detecting acute ischemic stroke.

MATERIALS AND METHODS

This study was conducted at Department of Medicine, Dow University of Health sciences OJHA Campus Karachi, Dow International Medical College Karachi (DIMC). Duration of study was 06 month from 1st October 2020 to 30th March 2021. Non-probability consecutive sampling technique was used. 460 cases were estimated by 95% confidence level with 5% margin of error and using percentages of abnormal EEG in 53.7% cases.

Inclusion criteria were acute ischemic stroke within 24 hours (diagnosed by CT brain & DWI), all

cases with age above 18 years of age, both genders. Exclusion criteria were patients with recurrent stroke (ischemic or hemorrhagic), known comorbid like hypertension/diabetes (FBS > 126 mg/dl), history of arterial fibrillation.

460 patients meeting inclusion and exclusion criteria were included in this study admitted at DUHS Karachi. The informed and written consent was taken from patients and attendants. Detailed history, examination and demographic data of the patient were recorded. The Diffusion weighted image or CT scan brain were performed immediately, and diagnosed as per diagnostic criteria of Stroke. Within 24 hours the EEG was done in all patients. The potentials recorded by EEG were cumulated excitatory and inhibitory postsynaptic potentials in neuronal dendrites, usually in most superficial regions of cerebral cortex. Abnormal EEG was labeled as per operational definition. The EEG was reported by the electrophysiology fellow. All data was entered and analyzed using SPSS v25.0. Mean \pm S.D was used for quantitative data like age, weight, BMI and height. Post-stratification, Chi-square test was used by taking p value \leq 0.05 as significant.

RESULTS

Total 460 patients were selected for this study. Mean age was 40.04 \pm 9.1 years. Among cases, there were 276 (60%) males and 184 (40%) females (table 1).

According to age distribution among cases, 138(30%) were in 18-40 years age group, while 322 (70%) were above 50 years of age groups respectively (table 2).

According to duration of acute stroke distribution, 276 (60%) had duration of disease for 3 days, while 184 (40%) had duration of disease for more than 4 days (table 3).

Among 460 patients, 235 (51.08%) had abnormal EEG (table 4).

By stratification of abnormal EEG, it was found that duration of acute stroke had significant effect having abnormal EEG (p = 0.000001) (table 5).

TABLE 1. Frequency distribution of gender

Gender	Frequency	Percent
Male	276	60
Female	184	40
Total	460	100

TABLE 2. Frequency distribution of age groups

Age groups	Frequency	Percent
18-40 years	138	30
>50 years	322	70
Total	383	100

TABLE 3. Frequency distribution of duration of stroke

Duration of Stroke	Frequency	Percent
1-3 days	276	60
>4days	184	40
Total	460	100

TABLE 4. Frequency distribution of abnormal EEG

Abnormal EEG	Frequency	Percent
Yes	235	51.08
No	225	48.90
Total	460	100

TABLE 5. Stratification of abnormal EEG with respect to duration of stroke

Duration of Stroke	Abnormal EEG		Total	p-value
	Yes	No		
1-2 days	207	69	276	0.000001
	75.00%	25.00%	100.00%	
>3 days	35	149	184	
	19.02%	81.00%	100.00%	
Total	235	225	460	
	50.08%	48.90%	100.00%	

DISCUSSION

Cerebrovascular accident is one of the major cause disability and dependency. Quantified electroencephalography (qEEG) is one of the latest techniques to evaluate the acute ischemic stroke. The latest case reports, however, do suggest a significant predictive value of qEEG for stroke recovery [13].

In a case study comparing the CT scan brain and conventional EEG in acute ischemic stroke, the results revealed EEG abnormalities in forty to fifty-five cases [14]. In this study, the prognostic mod-

els including crude EEG irregularities accurately characterized a higher level of patients than the model including only the definitely known stroke result indicators.

The research study by Finnigan et al. demonstrated that intense quantitative EEG information may be utilized to screen and foresee stroke development [15].

In research studies, power range density within a few frequency electrical activities, was generally used to analyze the EEGs of patients with stroke, particularly in theta and alpha activities, and made some empower results. The study of Kayser-Gatchalian et al. and, as in our study, with an unfavorable stroke outcome by Cillessen et al., reported that slow background activity on EEG was correlated with clinical severity of stroke [16,17]. The creativity of our study remains in the meaning of electroencephalographic free indicators of stroke utilitarian result, either at short and at long term, in any event, when adapted to age and clinical and imaging severity of stroke. Brain symmetry index (BSI) recorded from EEG recordings were consistent with NIHSS score and size of lesion in MRI [17].

CONCLUSIONS

The role of complexity of abnormal electroencephalogram is useful following acute ischemic stroke. The various parameters of EEG help to evaluate the large ischemic stroke.

This is the research of EEG microstates in acute stroke, and it opens up an intriguing approach for identifying neural abnormalities with prognostic significance, as well as developing richer compensatory therapy to help people recover faster.

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