EEG CHANGES IN VASCULAR DEMENTIA

Psychiatry	
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ABSTRACT

Background- As the age of general population is raising the prevalence of vascular dementia (VaD) along with other dementias are also rising. VaD is the 2nd common form of dementia after Alzheimer's disease. There is no confirmatory test for dementia diagnosis. Many studies support the possibility for EEG to detect dementia in early stages by the use of EEG. Dementia in Creutzfeldt-Jakob disease has triphasic wave form in EEG as criteria for it diagnosis under ICD-10. Researchers are going for other types of dementias to make their diagnosis easy and affordable and cost effective. According to some studies EEG could be used as a diagnostic tool, as well as for predicting the stages of dementia as it can identify the neuronal activities and cognitive manifestation in dementia through techniques of EEG signal analysis and processing.

Aims & Objectives-
1) To study EEG changes in vascular dementia.
2) Compare EEG changes in vascular dementia wit healthy controls.

Material & Methods- forty vascular dementia participants and forty healthy elderly controls above age 55 years were included in this study. Participants were taken from Dept of psychiatry, MGM Medical College and MYH, Indore fulfilling the inclusion and exclusion criteria. Written informed consent will be taken after explaining the objectives and procedure of study in detail. The EEG of participants has been recorded in Mental Hospital Banganga by using departmental RMS® EEG Systems Maximus version 4.2.54. © 2007-2008. EEG were recorded in eyes closed, on intermittent photic stimulation and hyperventilation, and there data were entered in excel sheet and analyzed using SPSS Software, appropriate statistical test was applied wherever necessary.

Results- participants with VaD have preponderance of theta wave as compare to control.

Conclusion – EEG can have additive value in diagnosing VaD as well as it alone can be helpful in differentiating healthy individuals from dementia patients.

KEYWORDS

EEG, vascular dementia, intermittent photic stimulation, hyperventilation

INTRODUCTION-

Vascular dementia may result either from ischemic or hemorrhagic Cerebrovascular Disease or from cardiovascular or circulatory disturbances that injure brain regions relevant to memory, cognition, and behavior. Vascular (formerly arteriosclerotic) dementia, which includes multi-infarct dementia, is distinguished from Alzheimer's disease by its history such as mode of onset, clinical features, and subsequent course. Sometime there is a history of Transient Ischaemic Attacks with some short lasting impairment of consciousness, fleeting pareses, or visual disturbances. The dementia may occur after acute cerebrovascular accidents or, less commonly, after a single major stroke. Thereafter some impairment of memory and thinking becomes apparent[1,2].

Onset usually in later life can be abrupt, following one ischaemic episode, or there may be more gradual emergence of Dementic symptoms due to cumulative effect of small infarcts. The clinical criteria for VaD comprise the diagnosis of dementia, the presence of large vessel or small vessel cerebrovascular disease demonstrated on brain imaging and a time relation between those features. In VaD impairment of cognitive function is commonly not equally distributed, so that there may be focal neurological signs, memory loss and intellectual impairment. Insight and judgement may be relatively well preserved as compared to Alzheimer's dementia. Abrupt onset and a stepwise deterioration, as well as the presence of focal neurological signs and symptoms, increases the probability of the diagnosis[2].

Affect on thinking and reasoning depends on stroke's severity and location[3]. Greater than 25 million people in the world are currently affected by dementia syndromes, with most individuals suffering from Alzheimer's Dementia (AD) and VaD[4, 5]. VaD is causally related to cerebrovascular incidents and diseases for example hypertension predisposes a person to the VaD. VaD account for 15 to 17 percent of all dementia cases. VaD is most common in persons between the ages of 60 and 70 and in contrast to AD is more common in men than women[6,7].

Aims & Objectives-
1) To study EEG changes in vascular dementia.
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METHODOLOGY- The study was conducted by including forty healthy controland forty people with VaD. The diagnosis of VaD dementia was made using the ICD -10 DCR. EEGs were taken on the same day with eyes closed, on intermittent photic stimulation (IPS) and hyperventilation (HV). Intermittent photic stimulation was given by flashes of light in increasing frequency from 1-30 Hz for about 2 minutes in every patient in increasing order. For good response we delivered photic stimulation (PH) from distance of about 25 cm from eyes. After photic stimulation Hyperventilation i.e. rapid deep breathing is performed in all participants for about 5 minutes.

The International system (IS) 10-20 system was used for electrode placement (with 19 electrodes). Even numbered 2,4,6,8 refer to electrodes placed on the right side of the head, whereas odd numbers 1,3,5,7 refer to electrodes on the left side of head. Lower the number means electrode placed in more central part of head and the "z" refers to the midline of head. We set low pass filter (Lf) at 1 Hz and high pass filter (Hf) at 70 Hz, sensitivity 7.5 µV/mm, Timebase 30mm/second, and notch filter at 50 Hz in all recordings.

We took about 20 minutes recording of each participant while resting with eyes comfortably closed and examine each EEG record in its full length. In each record we select 10 seconds of artifacts free page in eyes closed and with the help of our EEG software we plot frequency distribution for them separately. The software depicts only 4 types of frequencies i.e. delta (0.5Hz to 4Hz), theta (5Hz to 8Hz), alpha (9Hz to 13Hz) and beta (14 Hz to 30Hz). The frequency of each channels and combined frequency were placed in excel sheets, they are further divided in right and left half as even numbers of electrodes represent right half of head and odd numbers represent left half. So even numbers channels frequencies are summed together and odd channels frequencies summed together. Thus data from control and VaD participants were prepared in eye closed state, on IPS and on hyperventilation.

RESULTS-
Table 1. Description of age of study participants in groups.

Age (in years)	Control group	VaD group
Mean	62.1250	66.9750
Median	58.0000	65.0000

Standard deviation	5.39795	9.71514
Minimum	55.00	55.00
Maximum	85.00	85.00

The mean age of control group was 62.1± 5.3 years and dementia group was 66.9± 9.7 years. According to the inclusion criteria minimum age was kept 55 years, maximum age was the 85 years in both groups of participants.

Table 2. Description of gender-wise distribution of study participants in three groups.

		Gender		Total
		Male	Female	
Group	Control	27	13	40
	VaD	29	11	40

The number of male participants was more in both groups as compared to female participants.

Table3. Comparison of **combined** Delta, Theta, Alpha and Beta frequency distribution with **eyes closed** between control group and VaD group.

	Control group		VaD group		p value
	Mean rank	Median	Mean rank	Median	
Delta	38.40	23.00	49.81	28.500	0.000*
Theta	39.16	21.00	82.50	36.000	0.000*
Alpha	89.95	34.00	59.45	19.500	0.000*
Beta	77.25	17.50	57.04	14.000	0.000*

*p value <0.05 was considered statistically significant.

The combined EEG Findings in eyes closed situation revealed a significant difference between the proportions of delta wave in EEG amongst different groups.

Significant difference was also observed between the median percent contributed by theta wave in the EEG of three groups. The similar were the findings with respect to alpha waves and beta wave.

Table 4. Comparison of **combined** Delta, Theta, Alpha and Beta frequency distribution with **PH on** between control group and VaD group.

	Control group		VaD group		p value
	Mean rank	Median	Mean rank	Median	
Delta	45.79	32.500	57.35	37.000	0.000*
Theta	45.66	20.500	72.16	28.000	0.002*
Alpha	78.45	21.000	59.45	16.500	0.000*
Beta	85.55	20.000	45.24	10.000	0.000*

*p value <0.05 was considered statistically significant.

The combined EEG of the whole brain also showed significant difference amongst three groups. As shown by p values.

Table 5. Comparison of **combined** Delta, Theta, Alpha and Beta frequency distribution with **HV on** between control group, VaD group and ADRD group.

	Control group		VaD group		p value
	Mean rank	Median	Mean rank	Median	
Delta	43.84	26.00	54.08	30.500	0.000*
Theta	43.90	23.00	78.58	32.500	0.000*
Alpha	80.91	26.50	59.76	19.500	0.000*
Beta	80.15	18.50	48.38	12.000	0.000*

*p value <0.05 was considered statistically significant.

DISCUSSION-
Alzheimer's disease and VaD present with similar clinical symptoms of cognitive decline, but the underlying pathophysiological mechanisms differ.

The mean age of control group was 62.1± 5.3 years and dementia group was 66.9± 9.7 years in our study. While Neto Emanuel et al used 40 participants in each group Healthy control and VaD, with 72.4111.16 and 52.214.38 years for VaD and NC respectively.[8] 31 with VaD (mean age: 75.2 yrs, M 43%) and a control group of 14 healthy subjects (mean age: 69.5 yrs, M 43%) [9]. In most of studies control group have less age

as compared to patient group as in our study[8,9]. The male participants were outnumbered as comparison to women, in all 80 participant female were only 24 (30%), contrast to our study Knut Engedal et al (2015) have 57% female participants and Emanuel et al (2015) have 49% female participants. As life expectancy for women is higher than men and age is major risk factor for dementia, so incidence of dementia is higher in women[10,11] whereas VaD prevalence is more in women as compared to Ad[12].

We found more male participants in both groups as compared to female the reason behind age and sex disparity between our study and other studies may be sociocultural or may be due to fact that as VaD is more common in male[12,13].

Many studies have demonstrated association between VaD and EEG changes[8,9,10,14,15]. In our study control group eyes closed median EEG recording showed maximum alpha and minimum beta waves, constituting (36% and 17.5% respectively) while in VaD in eyes closed state the Theta wave was maximum (median 34%) and minimum by Beta wave (14%); which was similar to other studies[16,17].

In healthy control brain activity showed increase in delta wave on PH on (24% in eyes closed to 33.1% in PH on) and decrease in alpha waves (33% in eyes closed to 25.4% in PH on). Theta and alpha waves distribution remain near the same (21.9% and 19.4% respectively) in PH on as comparison to eyes closed recording. In VaD theta wave preponderance in combined recording in eyes closed state was reduced on PH on from 36% to 28%. The combined median theta wave remains higher as compare to healthy control on PH on state (20.5% in healthy control and 28% in VaD). These patients are as reactive to Photic stimulation as healthy control participants. On HV there is increased in slow waves in healthy control group, but alpha wave remain in majority (34% in eyes closed and 26.5% on HV), the VaD group was also reactive to HV and here also the slow waves increased on HV but here theta wave was in preponderance before and after HV. As VaD is not a neurodegenerative disorder like AD, EEG changes in VaD do not show the progressive course as observed in AD, so static finding on regular EEG can support possibility of having VaD[14].

CONCLUSION-
Normal EEG recordings with preserved alpha and beta waves make the possibility of having dementia unlikely while in VaD group theta wave was in majority as compared to healthy control group and with near normal reactivity as found in healthy controls to stimulating maneuvers. Thus EEG recording can serve as potential marker for VaD patients.

Recommendation-
the brain imaging techniques can localize the vascular lesion but cannot measure the cognitive deterioration as accurately as measured by EEG. EEG study should be advised if clear clinical indications are present. Regular EEG recording can monitor patient's cognitive changes. EEG may also differentiate between a generalized and a focal abnormality, and guide the clinician to further appropriate imaging studies.

Limitation of the study-
1. Severely demented patients have difficulty in understanding instructions during EEG recording leads to poor EEG recording hence not included in study.
2. Other dementia types were not included.
3. Dementia severity rating scales were not used.

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