

Study of EEG Changes in Patients With Hepatic Encephalopathy



Medical Science

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Dr. Nikhil Kumar Atolia

Post graduate student, Department Of Medicine, B.J. Medical College, Ahmedabad

Dr. Kamlesh J. Upadhyay

Professor, Medicine Department, B.J. Medical College, Ahmedabad. 380016

Dr. Sarita Parmar

Assistant Professor, Medicine Department, B.J. Medical College, Ahmedabad. 380016

Dr. Maulik Patel

Post graduate student, Department Of Medicine, B.J. Medical College, Ahmedabad

ABSTRACT

Objective: To study the EEG changes in patients with hepatic encephalopathy (HE) and correlate them according to the grade of encephalopathy.

Method: This study was carried out at Civil Hospital, Ahmedabad from January 2014 to October 2015. A total 35 patients with hepatic encephalopathy were taken and examined for clinical and laboratory parameter. EEG recording was done for every patient with standard international 10-20 electrode placement system. Data was analyzed and results obtained.

Results: 7 (20%) patients had grade 1 hepatic encephalopathy, 11 (31.42%) patients had grade 2 HE, 11 (31.42%) patients had grade 3 HE and 6 (17.14%) patients had grade 4 HE. In EEG finding, alpha wave was in majority in grade 1 HE (85.71%). Grade 2 HE predominantly had theta wave (81.82%), grade 3 HE had predominantly triphasic wave (81.82%) and delta wave was predominant in grade 4 HE.

Conclusion: As the grade of hepatic encephalopathy increases frequency of wave decreases and waves with slower frequency i.e. theta, delta or triphasic wave begin to appear in EEG. Further studies are required in community on large scale, for the analysis of EEG changes in patients with hepatic encephalopathy.

Introduction:

Hepatic encephalopathy (HE) is a debilitating complication of cirrhosis which presents as a spectrum of neurological and neuropsychiatric dysfunction, affecting the patient's consciousness, intellect, personality and neuromuscular activity. Hepatic encephalopathy as a complication of cirrhosis leads to physical complication that affect function and performance of daily life such as fatigue, muscle cramps and asterixis, to neuropsychological complication such as shortened attention, disorientation in time or space, changes in personality and inappropriate behavior.

Diagnosis of hepatic encephalopathy is clinical with supportive evidence from laboratory investigation like blood ammonia, psychometric analysis, neurophysiology like electroencephalography (EEG) and radiologic imaging.

As the grade of hepatic encephalopathy increases, there is an initial slowing in frequency with increasing amplitude in EEG from alpha rhythm, the amplitude then decreases and finally there is an absence of rhythmic activity. Triphasic waves are specific for metabolic encephalopathy, suggestive of severe grade of hepatic encephalopathy.

The present study is an attempt to study the changes in pattern of EEG from normal in patient with hepatic encephalopathy and prognosis on the basis of grade of encephalopathy. EEG can be used to detect minimal hepatic encephalopathy in patients with cirrhosis.

Materials and Method:

It was a prospective observational study carried out at a tertiary care center in India at Civil Hospital, Ahmedabad from January 2014 to October 2015. A total of 35 patients of >12 years of age, which were diagnosed as a case of hepatic encephalopathy, were studied. All patients presenting with history, symptoms & signs suggestive of Hepatic Encephalopathy without any evidence of any other metabolic encephalopathy with consent of patients or their relatives were taken.

All cases were subjected to investigations, this comprised of Complete blood count, Urine routine & microscopic examination, Renal function test, Liver function test, Prothrombin time, Serum Ammonia, Serum Albumin, HIV, HBsAg, anti-Hepatitis A virus antibody, anti-Hepatitis E virus antibody, Anti HCV antibody, Ultrasound of abdomen, EEG and any imaging modality (CT or MRI).

EEG was taken by standard international 10-20 system of electrode placement. Background activity was recorded and then hyperventilation (those who were able to follow command) and phonic stimulation was given and activity recorded. EEG was done within 48 hours of admission.

Data entry was done in Microsoft excel sheet, calculation done for various parameter and detailed analysis was done.

Results:

In present study, common presenting symptoms were yellowish discoloration of urine and sclera (82.86%), abdominal distension (60%), altered sensorium (45.7%). Major cause of hepatic encephalopathy was alcoholic liver disease (65.6%). Common precipitating factor for hepatic encephalopathy were hyponatraemia (Serum Sodium <135 mEq/L) (54.28%), hypokalemia (Serum Potassium <3.5 mEq/L) (34.28%), septicaemia (WBC count > 11000/cumm) (35.28%).

Taking into account the toxic effect of ammonia on the central nervous system, serum ammonia was assessed in all patients. Serum ammonia was raised (>65 $\mu\text{mol/L}$) in 32 (91.43%) of patients while it was normal (<65 $\mu\text{mol/L}$) in 3 (8.57%) of patients. Serum ammonia is a useful diagnostic marker for hepatic encephalopathy. But its value does not signify the degree of hepatic encephalopathy.

As per West Haven criteria, out of 35 patients, 20% patients were in grade 1 hepatic encephalopathy, 31.42% patients in grade 2 HE, 31.42% patients in grade 3 HE and 17.14% patients were in grade 4 HE.

A patient with hepatic encephalopathy had more than one wave form, but in a specific grade of hepatic encephalopathy one wave form pattern was predominant. Alpha wave was common in grade 1 patients, theta wave was common in grade 2 patients, triphasic wave was common in grade 3 patients and delta wave was common in grade 4 patients. There was significant association between the grade of hepatic encephalopathy and waves of EEG with p value 0.046 (p<0.05). As the grade of hepatic encephalopathy increases, frequency of EEG wave decreases.

Table 1: EEG findings

EEG finding	No of patients (n=35)			
	Grade 1 (7 patients)	Grade 2 (11 patients)	Grade 3 (11 patients)	Grade 4 (6 patients)
Alpha wave	6	5	1	1
Theta wave	5	9	7	2
Delta wave	0	2	6	5
Triphasic wave	1	7	9	3

Patient prognosis can be assessed by the EEG findings. It was observed that patients with delta wave had highest mortality [7 (53.85%) out of 13 patients], followed by triphasic wave [5 (25%) out of 20 patients], theta wave [4 (17.39%) out of 23 patients] and alpha wave [0 (0%) out of 13 patients].

Discussion:

Hepatic Encephalopathy (HE), also known as Porto-systemic encephalopathy, is the occurrence of confusion, altered level of consciousness, and coma as a result of liver failure. In the advanced stages it is called hepatic coma or Coma Hepaticum. It may ultimately lead to death. [1] The term implies that altered brain function is due to metabolic abnormalities.

Encephalopathy much more commonly seen in chronic liver disease. An important prerequisite for the syndrome is diversion of portal blood into the systemic circulation through portosystemic collateral vessels. [2] It is resulted in accumulation of toxic substances in the bloodstream that are normally removed by the liver. There are a number of key factors that determine the development of hepatic encephalopathy i.e. Gut - derived neurotoxins, Brain water homeostasis, Oxidative/ nitrosative stress, Astrocyte dysfunction, Neurotransmitter dysfunction, Infection and inflammation. Attacks are often precipitated by an intercurrent problem, such as infection, gastrointestinal bleeding, electrolyte disturbance or constipation. [1] [3] Expression of encephalopathy is characterized by personality changes, intellectual impairment, and may advance to a depressed level of consciousness.

Electroencephalography (EEG) is an electrophysiological monitoring method to record electrical activity of the brain. Hepatic encephalopathy is characterized by a progressive slowing of the normal alpha frequency of 8 to 13 Hz. Bursts of slow activity are observed in the theta (4-8 Hz) range, initially in the temporal areas, and then more diffusely over the scalp; further slowing into the delta (1-4 Hz) range may then occur. Triphasic waves or arrhythmic delta activity occur with more severe grades of encephalopathy; coma is characterized by slow, low voltage delta activity with sequences of electric silence. Triphasic waves are high-amplitude (>70 µV), positive sharp transients that are pre-

ceded and followed by negative waves of relatively lower amplitude. [4]

The sensitivity of the EEG for the diagnosis of hepatic encephalopathy varies. The best results are probably obtained using spectral analysis-based techniques. Abnormalities of the EEG are reported in 43 to 100% of patients with overt hepatic encephalopathy and in 8 to 40% of clinically unimpaired patients with cirrhosis. [5]

In a study by Kang Min Park et al, June 2014, demonstrated that patients with triphasic waves in metabolic encephalopathy had more significant impairment of brain function. Out of 60 patients with metabolic encephalopathy, 13 (21.67%) patients had triphasic waves. These patients had more severe electroencephalographic alteration and had poor prognosis. [6]

In a study by Van der Rijt et al (1984), of 66 patients with cirrhosis of liver (median age 60, range 21-75), showed a distinct slowing of the mean dominant frequency with increasing grade of hepatic encephalopathy, but there was a large overlap of individual data in adjacent group. It showed theta wave was more prominent in grade 1 (61.6%) while delta wave was more prominent in grade 4 (82.7%). [7]

Table 2: Comparative analysis in the frequency of Theta wave

Study	No of patients with Theta wave (%)			
	Grade 1	Grade 2	Grade 3	Grade 4
Van der Rijt et al [7] (1984) (n=66)	61.6	38.4	10.2	9.5
Present study (n=35)	71.4	81.8	63.6	33.3

In our study, frequency of theta wave was higher in all the grades of hepatic encephalopathy as compared to the Van Der Rijt et al (1984) study.

Table 3: Comparative analysis in the frequency of Delta wave

Study	No of patients with Delta wave (%)			
	Grade 1	Grade 2	Grade 3	Grade 4
Van der Rijt et al [7] (1984) (n=66)	13.4	56.8	78.4	82.7
Present study (n=35)	0	18.2	54.5	83.3

In present study frequency of delta wave was less in grade 1, 2 and 3 of Hepatic encephalopathy as compared to the Van der Rijt et al (1984) study. While in grade 4 of Hepatic encephalopathy, frequency was almost equal.

Conclusion:

In our study, 7 (20%) patients had grade 1 hepatic encephalopathy, 11 (31.42%) patients had grade 2, 11 (31.42%) patients had grade 3 and 6 (17.14%) patients had grade 4. In EEG finding, alpha wave was in majority in grade 1 (85.71%). Grade 2 predominantly had theta wave (81.82%), grade 3 had predominantly triphasic wave (81.82%) and delta wave was predominant in grade 4. There was association found between the grade of hepatic encephalopathy and waves of EEG (p value=0.046).

As the grade of hepatic encephalopathy increases, the EEG frequency decrease and mortality increases. In present study, patients with delta wave in EEG had highest mortality while patients with alpha wave in EEG had no mortality.

EEG in patients with hepatic encephalopathy can be used to detect minimal hepatic encephalopathy. EEG can also be used to detect the prognosis in patients with hepatic encephalopathy. As this study was performed in only 35 patients, further studies are required in community on large scale, for the analysis of EEG changes in patients with hepatic encephalopathy, for the assessment of prognosis of the disease and to show the effectiveness of treatment modality according to changes in EEG.

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