Original Article

Electroencephalographic Changes And Cognitive Function In Elderly Type 2 Diabetes Mellitus Patients

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Abstract: Background: In elderly Type 2 Diabetic patients cognitive function may get adversely affected. Diabetic patients are more prone to develop memory loss. Material & Methods: 30 Type 2 Diabetic patients and 30 normal healthy individuals whose age and sex matched with the cases were selected for the study. EEG recordings were done using Neuromax 64 channel instrument by MEDICAID systems and cognitive function was assessed using Mini mental status examination scores. Results: Elderly Type 2 Diabetes Mellitus patients have decreased cognitive function (MCI - Mild Cognitive Impairment). Slow wave activity is increased in type 2 diabetic patients compared to controls. Theta and Delta wave activity is also increased in cases compared to controls. EEG also showed increased alpha 2 wave activity and decreased alpha 1 wave activity among cases compared to controls. Conclusion: Various pathways of glucose metabolism in hyperglycaemia may be the main reason behind Mild cognitive impairment and abnormal EEG findings. [Amin R Natl J Integr Res Med, 2020; 11(2):08-10]

Key Words: Mild cognitive impairment, Diabetes Mellitus, Electroencephalogram

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Introduction: Diabetes Mellitus is a group of common metabolic disorders characterized by high blood sugar level over a prolonged period of time. It is characterized by polyphagia, polydipsia and polyuria. Type 2 Diabetes mellitus is more common among the two types of diabetes. Globally an estimated 463 million adults are living with diabetes. India is at the second spot in world having 62 million people living with diabetes mellitus. Type 2 Diabetes Mellitus patients with increasing age are at increased risk of having memory loss and judgement impairment.

Type 2 diabetes mellitus is characterized by increased insulin resistance, decreased peripheral glucose utilization and increased blood glucose level along with dyslipidaemia. Various glucose metabolism pathways like polyol(Sorbitol) pathway, Hexose monophosphate shunt pathway, advanced glycation end products, Protein kinase c pathway increases oxidative stress and they may be responsible for cognitive impairment in elderly diabetic patients.

For detection of cognitive impairment Mini-Mental state examination and EEG can be done. Cognitive dysfunction of Type 2 diabetic patients differs according to age, sex and duration of the disease. Present study is aimed at evaluation of EEG changes and cognitive function impairment in elderly type 2 diabetes mellitus patients.

Objectives: (1) To assess the cognitive function of elderly type 2 diabetic patients by mini mental status examination and to compare it with that of normal healthy individuals.(2) To do and analyse Electroencephalographic recording of both the groups.

Material and Methods: Present study is a type of comparative analytical study. Permission from ethical committee was taken for conducting this study. Consent was taken from both the cases and controls before their enrolment into the study. 30 Type 2 diabetic patients after having checked their random blood sugar were selected as cases and 30 normal healthy individuals whose age and sex matched with cases were taken as controls. Both the cases and controls were checked for cognitive function by Mini-Mental state examination.

The Mini Mental status examination or Folstein test is a 30 point questionnaire that is used extensively in clinical and research settings to measure cognitive impairment. Administration of MMSE takes between 5 and 10 minutes and examines functions including registration (repeating named prompts), attention and calculation, recall, language, ability to follow commands and orientation.

MMSE scores of both the groups were compared and statistically analyzed. EEG recordings in both the cases and controls were done using Neuromax 64 channel instrument by MEDICAID systems in Department of Physiology, B.J. Medical college, Ahmedabad. The 10-20 system

of electrode placement was used. Different types of EEG wave activities were checked in both the cases and controls. Data collected from both the groups was statistically analysed.

Study Design: Comparative Analytical Study.
Sample Size: 30 Cases And 30 Controls

Inclusion Criteria: 30 Type 2 Diabetic patients aged more than 45 years and having diabetes for atleast 5 years were included in this study.

Controls: 30 Normal healthy individuals who were matched in age and sex with the cases were taken as control group.

Exclusion Criteria: Patients Having Cardiovascular diseases, Psychiatric disorders, Metabolic syndrome, Major endocrine disorders other than Diabetes were excluded from the study.

Statistical Analysis: Data was systematically collected and entered in excel sheet via Microsoft office 2019 version. Data was analysed by student t test and p value less than 0.05 is considered as significant.

Results: Mini mental status examination showed significantly lowered MMSE scores in cases(27.2) compared to that of controls(28.8). these lowered MMSE scores are suggestive of cognitive impairment. Slow wave activity is increased in type 2 diabetic patients compared to controls. Theta and Delta wave activity is also increased in cases compared to controls. EEG also showed increased alpha 2 wave activity and decreased alpha 1 wave activity among cases compared to controls.The relative power of frequency bands can be calculated by $RP(f1,f2) = P(f1,f2)/P(1,45) \times 100\%$ where P indicates power, RP indicates relative power, f1, f2 indicate the low and high frequency, respectively. Alpha 2 activity is significantly increased in cases 32.39 ± 9.43 compared to controls 19.12 ± 6.25. (p value - 0.001). while Alpha 1 activity is significantly decreased in cases 21.37 ± 8.49 compared to controls 33.29 ± 6.48. (p value – 0.004).

Table: 1 Comparison Of Mini Mental Status Examination Scores And P Value Between Diabetic And Control Groups

Factor	Cases	Controls	P value
MMSE scores	27.2±0.5	28.8±0.3	0.002

(p value <0.05 is considered significant.)

Table: 2 Comparison Of Relative Power Of Alpha 1 And Alpha 2 Bands Of EEG Of Both Cases And Controls

	Cases		Controls		
	Mean	±SD	Mean	±SD	P value
Alpha 1	21.37	8.49	33.29	6.48	0.004
Alpha 2	32.39	9.43	19.12	6.25	0.001

(p value <0.05 is considered significant.)

Discussion: Type 2 diabetes mellitus increases risk of cognitive impairment and that may lead to dementia and Alzheimer's disease.

Mini mental status examination of elderly type 2 Diabetes mellitus shows significantly lowered scores (27.2) compared to that of controls(28.8). These decreased MMSE scores are suggestive of Mild cognitive impairment. Due to MCI there occurs learning disability, judgement impairment and memory loss. Similar results were also found in LA Zilliox et al[8], E saedi et al[7], MN Munshi et al[9], Dr.s Bathiun et al[3], Ahmed abo hagar et al[2]. In Dr.s Bathiun et al study MMSE score of cases are 26.8 which are lower compared to 28.6 of controls.

Physiological Basis: In Type 2 Diabetes mellitus there occurs persistent hyperglycaemia and in that glucose is metabolized via various alternative pathways like hexose monophosphate shunt pathway, protein kinase c pathway, advanced glycation end products, sorbitol(polyol) pathway etc. All these alternative pathways leads to increased oxidative stress by production of reactive oxygen species and that is considered as main reason for mild cognitive impairment in elderly diabetic patients. Insulin resistance and hyperglycaemia leads to vascular damage which in turn leads to neurodegeneration.

In electroencephalographic findings increased alpha 2 and decreased alpha 1 activity has been seen in elderly diabetic patients compared to controls. Similar results were also found in Zhijie Bian et al[6], Ahmed abo hagar et al[2] and Dr.s Bathiun et al[3]. In Dr.s Bathiun et al study Type 2 Diabetic older individuals shows slow EEG activity in central cortex and reduced alpha wave activity in parietal area.

Physiological Basis: Increased alpha 2 activity is due to a progressive recruitment of many other cortical areas that involve wider cortico-thalamic

re-entry loops or it may be due to hyperpolarization at thalamic level. Increased alpha 1 activity suggests good memory performance enhancing the cognitive function in normal individuals. But in Type 2 Diabetic patients alpha 1 activity is decreased which is suggestive of decline in cognitive function. Slow wave activity is increased in type 2 diabetic patients compared to controls.

Increased theta and delta wave activities are also seen in cases compared to controls.

Conclusion: To prevent Dementia, memory loss, impaired learning and judgement and for early detection of cognitive impairment in elderly Type 2 diabetes mellitus patients EEG screening and mini mental status examination should be promoted during regular health check-ups.

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