ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 01 | January - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

IMPLEMENTATION OF VISUAL EVOKED POTENTIAL FOR THE DETECTION OF PRERETINOPATHY AND PROGNOSTICATION IN DIABETES MELLITUS

Neurology

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ABSTRACT

Introduction: Diabetic Retinopathy (DR) is one of the complications of Diabetes Mellitus (DM) which affects the retinal blood vessels. It is one of the preeminent causes of blindness in the age group of 20 to 74 years albeit that visual loss due to it may be preventable by adequate glycaemic control. Visual Evoked Potential (VEP) can be used in diagnosis of retinal changes and ascertainment of prognosis can be done by it. **Aim:** To evaluate the ability of VEP in identifying preclinical neuro-degenerative changes in patients with diabetic preretinopathy by studying changes in VEP. **Materials and Methods:** This study comprises of 30 diabetic patients without retinopathy and 30 non diabetic controls. Patients were selected from the outpatient Department of Ophthalmology for the screening of DR. Latency of P100 was analysed because of its reliability and less inter-subject variability. Mean P100 wave latency of both groups were compared and analysis was done regarding any discrepancy in P100 wave latency with respect to the duration and the control of diabetes. Data was analysed using IBM-SPSS 27. Student's t- test was applied when two groups were compared whereas Analysis of Variance test was applied for multiple group comparisons. The p value <0.001 was considered statistically significant. **Results:** There was significant prolongation of P100 latency in diabetics without retinopathy. It was also observed that there was positive correlation between prolongation of P100 latency and duration of diabetes. **Conclusion:** VEP could be a better tool for the detection of very early retinal changes before any clinical evidence of retinopathy has set in. Adequate glycaemic control, dietary modification, appropriate dosage of medications could prevent the early development of retinopathy if done at this stage.

KEYWORDS

P100 latency, Visual evoked potential, Haemoglobin A1C

INTRODUCTION

Diabetic Retinopathy is one of the preeminent disabilities caused by DM and visual loss may be prevented by adequate glycaemic control or photocoagulation. [1-5] The prevalence of Diabetic Retinopathy in population aged 20 years and above was 7.7% in 2016 with highest in Kerala followed by Tamil Nadu and Delhi.

An estimated 438 million people will be affected by DM in the year 2030 in India.[6] Visual deficits in DM can affect the retina, optic nerve which results from vascular as well as metabolic complications of DM. Deterioration of retinal vasculopathy causes loss of blood vessel integrity with fluid leakage into the retina. The consequence of all these is maculopathy which causes visual impairment and later blindness.

One of the primary goals of management in diabetic patients is to avoid the risk of DR. [7] But it's not possible clinically to detect early retinal changes as the neural retina of diabetic eyes undergoes subtle functional changes.[8]

Its pertinent to mention here the analysis in pattern of VEP responses, which may provide early diagnosis of such diabetic changes and thereby helping in determining prognosis during treatment[9]

The primary aim of the study was to investigate the ability of VEP in detecting preclinical neurodegenerative changes in patients with diabetic preretinopathy. The secondary aim was to study correlation between changes in P100 latency and duration of diabetes and diabetic control.

MATERIALS AND METHODS

This descriptive study was conducted in the outpatient Department of Neurology and Ophthalmology of Government Thoothukudi Medical College and Hospital, Tamilnadu, India from January 2022 to June 2022.

Inclusion Criteria

DM patients attending the Outpatient Department of Ophthalmology, Government Thoothukudi Medical College and Hospital, Thoothukudi for screening of DR, without any clinical evident retinopathy who were willing for the study, were included as subjects. Age matched controls were taken from the bystanders of the patients coming to the outpatient department.

Exclusion Criteria

Subjects with long standing history of stroke, Hypertension, cataract, glaucoma, optic atrophy were excluded.

Sample size was calculated by using the formula:

$N = Z^2 1\text{-}\alpha/2 \times S^2/d^2$

N= sample size

Z= 1.96 (for α error at 5%)

S= sample standard deviation (was 5.3% obtained from previous study)[6]

d= variability

$$N = \frac{1.96 \times 1.96 \times 5.3 \times 5.3}{1.8 \times 1.8}$$

= 33 (rounded off to 30 patients)

Thus, 30 cases and 30 age matched controls were included in the study.

Procedure of the test was explained and written consent was taken. A brief history was taken and general examination in addition to neurological examination was done.

Procedure

Ophthalmological examination of all subjects was carried out including visual acuity and fundus examination. VEP recording was done using the pattern reversal stimulation. Patients were advised to come without applying oil to the scalp. The skin was abraded and degreased. Monocular pattern reversal checker board pattern of frequency 1.8 Hz was used. The patient's gaze was made to be fixed at the centre of the screen; distance between monitor and patient being 100 cm.

Average 200 sweep stimuli were given to each eye to assess the visual function by P100 wave latency. Silver disc electrodes were placed at Grounding (FPZ), Active (OZ), Reference (FZ); that recorded the bioelectrical signals. These electrodes were placed according to the 10-200.00 international system of EEG placement. Uniform illumination was maintained in the room. The electrode impedance was kept below 5kΩ.The evoked potentials were averaged and analysed by (EMG 2000 Medicaid machine). Peak P100 latencies were recorded and analysed.

Statistical Analysis

Data was analysed using IBM SPSS 27. Subjects were divided into three groups depending upon the duration of diabetes. Mean of P100 wave latencies were found out in the subjects and compared depending upon the duration of diabetes. Student's t-test was applied when the two groups were compared, while ANOVA (Analysis of Variance) test was applied for multiple group comparisons. The p-value <0.001 was considered significant in this study.

RESULTS

The mean P100 latency of DM group was 121.43±4.52 msec and that of non-diabetic was 97.36±3.63 msec [Table1]. The difference was found to be statistically significant with a T value of 22.74 at p- value of <0.001.

Table 1:P 100 wave latency in diabetic and control subjects

Group	N	Mean P100(msec)	Std. deviation	Std.error mean
Diabetic	30	121.43	4.52	0.841
Non diabetic	30	97.36	3.63	0.675

The mean P100 latency in patients with duration of diabetics upto 5 years was 116.3±4.08 msec. In patients with duration of diabetes in the range of 6-10 years, the mean P100 latency was 123.2±1.26. Mean P100 latency in patients with duration 11-15-year diabetes was 126.4±1.51msec [Table 2]. On ANOVA the difference was found to be statistically significant with san F value 32.22 at p- value <0.001.

A strong positive correlation was observed between the duration of DM and mean P100 latency which was statistically significant (r=0.707, p<0.001) [Figure-1].

Table 2: Analysis of Mean P100 with varying duration of diabetes mellitus.

Duration of DM	Mean P100(msec)	N	Std.deviation (msec)
Upto 5 years	116.30	10	4.083
6-10 years	123.21	15	1.26
11-15 years	126.40	5	1.51

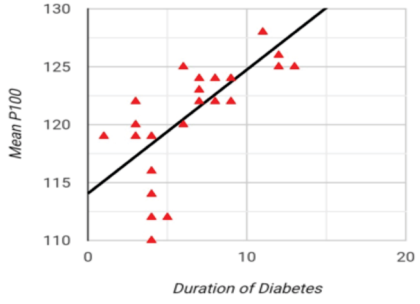

Figure 1: Correlation between duration of diabetes and Mean P100 wave latency

Mean P100 latency in individuals with different ranges of HbA1C is shown in [Table 3]. On ANOVA the difference was statistically significant with a F value of 8.52 at p value <0.001.

Table 3: Comparing HbA1C values with mean P100.

HbA1C	Mean P100 (msec)	N	Std. deviation (msec)
< or = 6 %	113.33	3	3.05
6.1-7%	120.33	12	4.99
7.1-8%	123.90	10	0 .56
>8%	124	5	1.87

DISCUSSION

In the present study, there was statistically significant correlation between prolongation of mean P100 latency and duration of diabetics. Mean P100 latency was significantly prolonged in poorly controlled diabetic group than with the good control. Mean P100 latency was prolonged in those with HbA1C >7%.

Chopra D et al., found prolonged P100 latency among diabetics and a significant correlation between the P100 latency delay and duration of illness [10]. Raman PG et al., had showed an increase in P100 latency with poor glycaemic control which was due to prolonged exposure to toxic glycaemic substances [11].

Marilyn ES et al., who studied the acute effects of blood glucose on VEP in people with diabetes; documented three mechanisms by which tissue function was altered; which includes action of polyol pathway, myoinositol depletion and non-enzymatic protein glycosylation [12].Parisi V et al., worked extensively on neural conduction in visual pathway, they explained that electrophysiological parameters did not correlate with blood glucose and HbA1C were not influenced by three months of relatively stable metabolic control[13].

Similar to our study MartinelliV et al., showed significant correlation between prolonged P100 latency and duration of diabetes[14]. Parisi V et al., observed that retinal and visual pathway function is differently impaired in diabetic patients with different duration of disease, having no signs of retinopathy [15]. Ghirlanda G et al., found that in diabetics with shorter duration of disease (3.8±3.5 years), early DM cause selective neurosensory deficits of the inner retinal layers, whereas the photoreceptors remain unaffected[9].

Limitation

Small sample size is the limitation of the present study and further work with larger sample is required.

CONCLUSION

VEP assessment shows the involvement of visual pathway in people with diabetes before the development of retinopathy. In contrast to the ophthalmological studies, electrophysiological investigation especially VEP is a highly sensitive method in monitoring the first phase of diabetes, particularly in determining the effects on visual function. VEP is recommended as an early investigation for proper management of this metabolic illness, which can lead to blindness.

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