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Research article

A STUDY ON EARLY DETECTION OF CHANGES IN VISUAL PATHWAY DUE TO DIABETES MELLITUS BY VISUAL EVOKED POTENTIAL

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ABSTRACT

Electrical potentials have been recorded by surface Evoked Potentials namely the Somatosensory Evoked Potential, Auditory Brainstem Response and Visual Evoked Potential [VEP]. Visual conduction disturbance can be evaluated by these instruments. A mass response of cortical and possibly subcortical may be represented, visual areas to visual stimuli. Diabetic patients without a past history of cerebrovascular accidents diagnosed with Non- Proliferative Diabetic retinopathy[DR] with a best corrected visual acuity at least 6/9. This study was done to assess whether a delay in VEP latency observed in diagnosed type II DM patients could be ascribed to dysfunction of the retinal or post retinal structures or by both. It is to find out whether the VEP latencies are altered in diabetes or not, if altered and to correlate duration of the diabetes mellitus with visual evoked potential changes. Visual evoked potentials are useful as a non invasive investigatory method in establishing central nervous system neuropathy developing in diabetes. This study clearly shows that changes in VEP may be detected in diabetics before the onset of retinopathy. Future studies should be focused on evaluation of the time that elapses between the appearance of the first detectable pathologic electrophysiologic changes and the first ophthalmoscopically detectable retinal changes in patients with Diabetes Mellitus [DM].

Keywords: Pattern reversal, Photostress, electrodes.

INTRODUCTION

Electrical potentials that occur in the cortex after stimulation of a sense organ, which can be recorded by surface electrodes, are known as Evoked Potentials [EP]. e.g. Somatosensory Evoked Potential (SEP), Auditory Brainstem Response (ABR) and Visual Evoked Potential (VEP).

A change has been observed over time with the clinical use of Electric potentials. There have been advances in imaging technology, especially in magnetic resonance imaging (MRI), have reduced the use of EP testing in clinical practice. MRI largely remains an imaging, structural, or anatomic test and therefore gives more accurate information about

structural problems. EP testing assesses functionality and thus supplies information about the physiology of a certain anatomic pathway, providing much less spatial or localizing information than MRI does.¹

These electric potentials are used in the detection of anterior visual conduction disturbance. A mass response of cortical and possibly subcortical may be represented, visual areas to visual stimuli.^{2,3} VEP affection is related to age of onset of diabetes and glycemic control. Any abnormalities in the visual pathway can be detected with the help of VEP much prior to appearance of visual symptoms or changes in fundus examination.⁴

These equipments permit one sectioning of structures which help in visual pathway neural conduction.⁵ Evaluation of bioelectric activity of the retinal layers is done with the help of electroretinographic signals with patterned stimuli (PERG)⁶.

The aim of this study is to evaluate the visual pathway abnormalities in diabetic patients without retinopathy and with non-proliferative diabetic retinopathy (NPDR) and to determine abnormal frequency and to investigate the relationship between other variables such as duration of diabetes and degree of metabolic control.

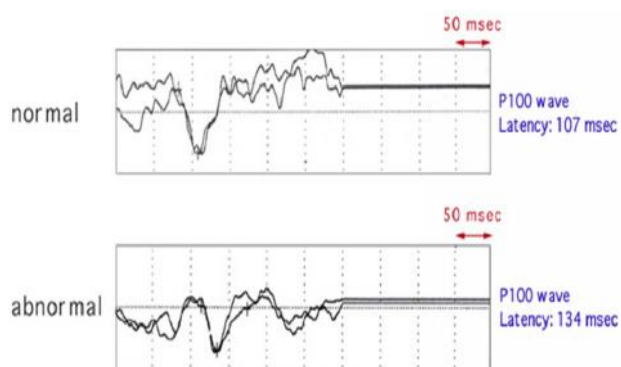


Fig 1: Visual evoked potential³

Aim & Objectives

Aim: Aim of this work is to assess whether a delay in VEP latency observed in diagnosed type II DM patients could be ascribed to dysfunction of the retinal or post retinal structures or by both.

Objectives: 1. To find whether the VEP-PR latencies are altered in diabetes or not. 2. To correlate duration of the diabetes mellitus with visual evoked potential changes.

MATERIALS AND METHODS

Experimental design: A cross sectional study.

Subjects: Patients were selected from the outpatient of Ophthalmology Department of Meenakshi Medical College & Hospital, Kanchipuram . An informed consent and ethical committee clearance have been taken for this study.

Inclusion criteria:

1. No past history of cerebrovascular accidents
2. Diabetic patients with duration of 1-10 years.
3. Non- Proliferative Diabetic retinopathy
4. Best corrected visual acuity at least 6/9

Exclusion criteria:

1. Cataract,
2. Glaucoma
3. Vitreous opacities or any evidence of optic atrophy
4. Peripheral nervous system disease
5. Proliferative diabetic retinopathy

General examination and systemic examination:

General examination was done in the Department of Ophthalmology and a detailed history of Cerebrovascular diseases, Cataract, Glaucoma, any Optic nerve pathology and TB was taken.

Visual evoked potentials were recorded using pattern reversal stimulation

Study Group: The study groups were divided into Group I, Group II and Group III.

Group I: 40 normal age and sex matched subjects, were selected as control group.

Group II: 40 subjects with DM Type II without retinopathy, with duration of diabetes varying from 1 year to 10 years

Group III: We evaluated 40 subjects with DM type II with non-proliferative retinopathy with duration of diabetes varying from 1 year to 10 years.

In this study waveform pattern latencies which are P 100 and N 75 and amplitude of VEP were chosen as the parameters. Visual Evoked Potential used from the Diopsys Nova Company with the electrodes placement on the scalp as shown in Fig 2: The diffuse light flash stimulus is rarely used due to the high variability within and across subjects. The checkerboard patterns utilize alternate light and dark squares and stripes, respectively. These squares and stripes which are equal are then presented one at a time via a computer screen.

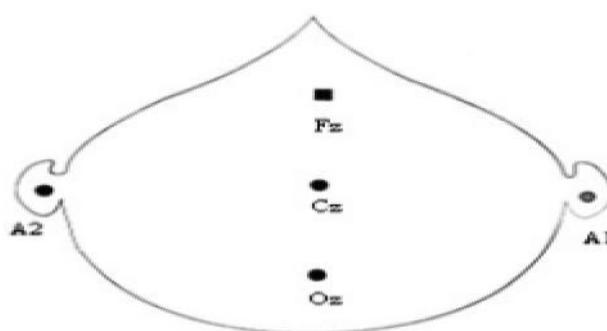


Fig 2: Placement of Electrodes, Scalp electrodes was used: 1.Frontal (FP2), 2. Occipital (O2), 3. Grounding (C2) electrodes⁶

Statistical Analysis: Student 't' test (Independent sample t test") was used for comparison of VEP between control and diabetes group. One way analysis of variance (ANOVA) was used for comparing the VEP latencies and amplitude with duration of DM and different level of glycemic control

RESULTS

Table 1: Tabulation comprising 40 patients studied over period of 10 years

	No. of Subjects	Age	Duration of DM
Group I	40	49.13 ± 4.52	-
Group II	40	52.70 ± 3.87	4.00 ± 1.76
Group III	40	53.33±4.39	5.47 ± 2.25

Table 2: Comparison of P100 latency, N75 latency of Visual Evoked Potential

	No. of Subjects	P100 latency (ms)	N75 latency (ms)	P value
Group I	40	93.82 ± 2	67.46 ± 5.28	< 0.0001*
Group II	40	100.30 ± 4.91	70.76 ± 6.77	< 0.0001*
Group III	40	107.30 ± 4.54	73.81 ± 4.58	< 0.0001*

* The mean difference is significant at the ≤ 0.05 level

Table 3: Comparison of Amplitude of Visual Evoked Potential between the groups

	No. of Subjects	Amplitude (μ v)	p value
Group I	40	7.52 ± 1.18	<0.0001*
Group II	40	3.61 ± 1.24	
Group III	40	2.77 ± 1.56	

* The mean difference is significant at the ≤ 0.05 level

Table 4: Relationship of various glycemic levels of Diabetes Mellitus with Visual Evoked Potential Latency (P100).

FBG (mg/dl)	No. of Subjects	P100 latency (ms)	Amplitude (μ v)	p value
<126	25	97.81 ± 4.25	4.35 ± 2.04	> 0.0001*
126-145	20	103.60 ± 3.07	2.92 ± 1.39	
>145	35	108.40 ± 3.70	3.28 ± 1.90	

* The mean difference is significant at the ≤ 0.05 level

Table 5: Analysis of P100 Latency in regard with different durations of Diabetes Mellitus:

Duration (yrs)	No. of Subjects	P100 latency (ms)	Amplitude(ms)	p value
<3	28	96.31 ± 6.38	5.54 ± 1.61	< 0.0001*
3 – 7	28	102.29 ± 1.72	3.30 ± 0.98	< 0.0001*
7 – 10	24	105.79 ± 2.92	1.83 ± 0.45	< 0.0001*

* The mean difference is significant at the ≤ 0.05 level

Relationship between duration of diabetes and VEP latency and amplitude: Among the subjects, the duration of type II diabetes mellitus was found to be between 1 year and 10 years with a mean of 4.73 ± 1.42 years. The subjects were distributed into 3 groups based on the duration of diabetes - Subjects > 3 years, 3 – 7 years and < 7 years duration of diabetes mellitus. **Amplitude of VEP and duration of diabetes:** The mean P100 – N145 amplitude was significantly

reduced with the increasing duration of diabetes. (p.value <0.05)

DISCUSSION

Peripheral and central neuropathy in diabetic patients can be determined by Electrophysiological investigations. Many patients who were clinically examined showed a decrease of nerve conduction velocity.

In our study it appears that pattern stimulated VEP (P100 and N75 latencies) in people with diabetes mellitus shows a distinct prolongation of the latency period which could be explained with findings of Karlica et al.³

In our study VEP latencies and amplitude was correlated with duration of diabetes and we found there was a significant changes in VEP. This could be explained from the basis of poor metabolic control, diabetes duration, dislipidemia and diabetic nephropathy and the probable physiological mechanism could be that VEP abnormalities for both eyes is associated with parasympathetic autonomic neuropathy and the hyposthetic form of lower-limb sensory neuropathy.

The mean N75 latency, P100 latency and P100-N145 amplitude were prolonged in those with HbA1c >7% but the difference were not statistically significant.

CONCLUSION

Visual evoked potentials are useful as a non invasive investigatory method in establishing central nervous system neuropathy developing in diabetes.

This study clearly shows that changes in VEP may be detected in diabetics before the onset of retinopathy.

This study also shows that the VEP changes may be related to the poor control and long duration of the disease, both of which were associated with significant VEP latency prolongation and decreased amplitude.

Thus VEP measurement is essential for the detection of pre retinopathy changes and has the potential to reduce DM complications.

Furthermore, it can be performed whenever a patient with diabetes without retinopathy shows a worsening of metabolic control, to evaluate the impairment of visual pathways. It is important to emphasise that, when tight metabolic control is achieved, these abnormalities disappear, suggesting that VEP impairment is only functional and completely reversible.

Future studies should be focused on evaluation of the time that elapses between the appearance of the first detectable pathologic electrophysiologic changes and the first ophthalmoscopically detectable retinal changes in patients with DM.

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