

VISUAL EVOKED POTENTIALS IN TYPE-1 DIABETES WITHOUT RETINOPATHY: CO-RELATIONS WITH DURATION OF DIABETESSanjeev Kumar Shrivastava¹, Virendra Verma², P.S. Tonpay³, Milind Shiralkar⁴, Nikhil Shrivastava⁵**HOW TO CITE THIS ARTICLE:**

Sanjeev Kumar Shrivastava, Virendra Verma, P.S. Tonpay, Milind Shiralkar, Nikhil Shrivastava. "Visual Evoked Potentials in Type-1 diabetes without Retinopathy: Co-Relations with Duration of Diabetes". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 05, February 03; Page: 1065-1070, DOI: 10.14260/jemds/2014/1946

ABSTRACT: 20 diabetic (Type 1) patients have been studied in order to investigate the possible effects of the type 1 diabetes mellitus on the central nervous system by means of pattern shift visual evoked potentials. Patients with diabetic retinopathy, glaucoma and cataract were excluded from the study. To evaluate central optic pathways involvement in diabetics, visual evoked potentials (VEP), in particular the latency of positive peak (P100), were studied in 20 patients and 20 normal controls using reversal pattern VEP. P100 latency was significantly increased in diabetics. A positive correlation was also found between latencies of VEP and duration of disease. Relationship between blood sugar level and P₁₀₀ wave latencies and amplitudes in diabetic patients was not significant. VEP measurement seems a simple and sensitive method for detecting early involvement and changes in optic pathways in diabetics.

KEYWORDS: Visual Evoked Potentials (VEP), P100 latencies, Diabetes mellitus (Type 1).

INTRODUCTION: Diabetes mellitus is a lifestyle non-communicable disorder which results from an interaction between environmental factors and genetic susceptibility.

In present scenario, diabetes poses a major health problem globally and is involved as one of the top five causes of death in developed countries with developing countries like India exhibiting a sharp upswing in its prevalence. It is predicted that by the year 2025, three-quarters of the world's 300 million adults with diabetes, will be in non-industrialized countries and almost a third in India and China alone.

The disease with its long asymptomatic stage and propensity to cause cellular damage and long term microvascular &/or macro vascular complications and involving a host of organ system is now considered a syndrome characterized by chronic hyperglycemia and disordered metabolism of carbohydrates, fats & proteins due to absolute or relative deficiency in insulin secretion &/or insulin resistance (National Diabetes data group). Impairment of central nervous system is a frequent complication of diabetes. Although exact pathophysiology of the central nervous system dysfunction is not clear, but it appears to be multi factorial, involving vascular and metabolic factors ¹.

In diabetes mellitus, visual deficit appears to result from both vascular and metabolic abnormalities, which can affect the retina, optic nerve and visual pathways. Visual evoked potentials are therefore used to evaluate optic neuropathy in diabetic patients. Evoked potential tests are simple, sensitive and objective technique for evaluating impulse conduction along the central nervous pathways ².

Examination of visual evoked potentials (VEPs) seems to be more useful for the evaluation of the effects of glycemic control on CNS function rather than evaluation of the effects of glycemic control on peripheral nervous system through examination of nerve conduction ³.

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The current study is aimed to evaluate the prevalence of visual evoked potential abnormalities in type 1 diabetic patients of both sex and different age groups.

MATERIAL & METHODS: The present work was conducted on 20 patients with type 1 diabetes mellitus. The patients were randomly selected without any bias for age, sex, types control and duration of the disease with 20 matched healthy volunteers serving as controls.

Exclusion Criteria:

1. Patients with history suggestive of diseases involving heart, renal system, liver and respiratory system, systemic hypertension, significant anemia (as per WHO criteria), electrolyte imbalance or resting abnormal ECG were excluded from the study.
2. Patients with retinopathy, glaucoma or opacification, or visual acuity <6/18 with corrective lenses.

METHODS: All subjects selected for the study were subjected to a standardized protocol comprising of history, clinical examination especially ophthalmic and other necessary investigations following which they underwent visual evoked potential (VEP) testing.

Precautions required before performing the test:

- Washing hair the night before and avoiding hair chemicals, oils and lotions.
- Ensuring adequate sleep on previous night.
- Test conducted with corrective lenses, if worn.
- Any medications that cause drowsiness and affect the size of pupil should be avoided.
- Physical and mental relaxation.

Equipment: Visual evoked potential (VEP) was recorded with an RMS equipment equipped with pattern-shift stimulator television screen, signal amplifier with filters, computer system for averaging.

VEP Recording: VEP test was performed in a specially equipped electro diagnostic procedure room (darkened, sound attenuated room). Initially, the subjects were made to sit comfortably approximately 100 cm away from the pattern-shift screen. Subjects were placed in front of a video monitor displaying black and white checkerboard pattern. The checks of alternate black/white to white/black were displayed at a rate of approximately two checks per second. Every time the pattern alternates, the subject's visual system generates an electrical response that was detected and recorded by surface electrodes, which were placed on the scalp overlying the occipital and parietal regions with reference electrodes on the midline of frontal region (Fz). The subjects were asked to focus his gaze onto the center of the screen. Each eye was tested separately (monocular testing).

Stimulation Pattern: The visual stimuli were checkerboard patterns (contrast 70%, mean luminance 50 cd/m²) generated on a video monitor and reversed in contrast at the rate of two reversals per second. At the viewing distance of 100 cm, the check edges subtend a visual angle of 15 minutes with

video monitor screen subtending an angle of 12.5°. The refraction of all subjects was corrected for the viewing distance.

Electrodes and Electrode Placement: Surface electrodes were fixed with paste in the following positions: active electrode at Oz (which is highest point on the occiput), reference electrode at Fz or 12 cm above theinion, ground on the vertex at Cz (Fig-1). The bioelectric signal was amplified (gain 20, 000), filtered (band-pass, 1-100 Hz), and 150 events free from artefacts were averaged for every trial.

RESULTS: The Student's t-test was used to statistically analyze and compare the various proportions which were derived in the different groups and the p-values were obtained. A p-value which was >0.05 was considered as non-significant, while a p value which was <0.05 was considered as significant and a p value which was <0.001 was considered to be highly significant.

The data revealed that:-

1. There was significant prolongation of P₁₀₀ latencies in type 1 diabetic patients as compared to controls (Table-1) i.e. 108±5.84 Vs. 96.25±4.03, p<0.05 and P₁₀₀ amplitudes decreased significantly (4.70±1.62, P<0.05).
2. The mean duration of diabetes in the population studied was 7.08±4.57 years with maximum number of cases (40%) having duration of diabetes less than 5 years. There was a positive relationship between the duration of diabetes and prolongation in P₁₀₀ latencies (Table-2) whereas P₁₀₀ amplitude did not show any relation with duration or severity of diabetes.

DISCUSSION: The P100 wave form is generated in the striate and peristriate occipital cortex due to the activation of the primary visual cortex and also due to the discharge of the thalamocortical fibers. N70 reflects the activity of the fovea and the primary visual cortex while N145 reflects the activity of the visual association area. The P100 is a prominent peak that shows relatively little variation between the subjects, minimal within-subject interocular difference, and minimal variation with repeated measurements over time Odem et al ⁴. Therefore, this paper focused more on the correlation P100 latency values among the groups which were examined.

In this study, the mean P₁₀₀ latencies in diabetic patients were significantly prolonged compared to controls (Table-1) i.e. 108±5.84 vs. 96.25±4.03, p value - 0.000 (p<0.05). These above findings are in accordance with the findings of Puvanendran et al ⁵, Algen et al ⁶ and Omer et al ⁷ who found significant correlation between the diabetes and prolongation P₁₀₀ latencies (Fig-2).

The P₁₀₀ amplitudes in diabetic cases had a mean value which was lower than the control (Table-1) i.e. 4.70±1.62 vs. 5.81±2.10. P₁₀₀ amplitudes decreased in diabetics significantly (p<0.05), although there are conflicting reports on the role of diabetes and the P₁₀₀ amplitudes ⁷.

There are conflicting reports regarding correlations between duration of diabetes and P₁₀₀ wave latencies. Present study has yielded significant correlation between duration of diabetes and P₁₀₀ wave latencies (Table-2). As duration of diabetes increased, P₁₀₀ wave latencies increased. There was no significant association found between P₁₀₀ amplitudes and duration of diabetes.

The above findings are in accordance with the findings of Yaltkaya et al ⁸, Maryani et al ⁹ and Omer et al ⁷ who found significant correlation between the two.

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However, Ziegler et al ¹⁰ have not found any significant correlation between VEPs and duration of diabetes.

Poor glyceemic control or hyperglycemia is central to the development of micro and macrovascular complications of diabetes.

In the present study, a relationship between blood sugar level and P₁₀₀ wave latencies and amplitudes in diabetic patients ($p>0.05$, insignificant) was not found.

This is in conformation with the findings of Algan et al. ⁶, Omer et al ⁷ who did not find any significant correlation between blood glucose level and visual evoked potential changes.

The prolongation of P₁₀₀ latencies, which are observed in diabetics, is thus an expression of structural damage at the level of the myelinated optic nerve fibers. The exact pathophysiology of the central nervous dysfunction is not clear, but it seems to be multifactorial, involving metabolic and vascular factors, which is similar to the pathogenesis of diabetic peripheral neuropathy. Ischemia, reduced protein synthesis, depleted myoinositol and high sorbitol levels have been demonstrated in patients with diabetes and these may result in nerve fibre loss in the peripheral nerves. Hence, it is possible that the optic nerve fibers may also suffer from these diabetes induced changes.

CONCLUSION: Thus, from the present study, it can be concluded that the changes in the VEP response occur in diabetic patients much before the development of overt retinopathy or clinically apparent sensory neuropathy and these changes are positively correlated with the duration of the disease. So, VEP measurement which is a highly sensitive, reliable, noninvasive and reproducible method for detecting the early alterations in the central optic pathways in diabetics, should be recommended whenever possible and these must be added to the list of screening tools for a more complete and early assessment of the neurological involvement of the diabetic patients to advise them for an early and proper management of the disease.

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Ground Electrode

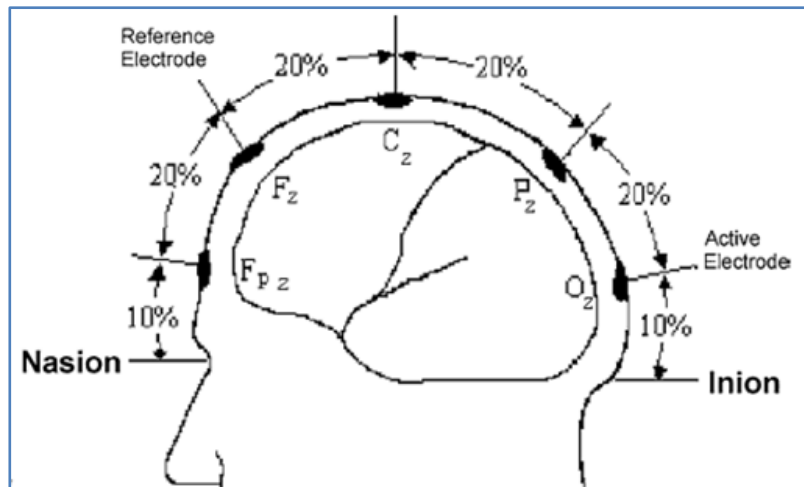


Fig. 1: Position of recording electrodes

Oz - active, Fz- reference electrode, Cz- ground electrode
(The subscript z indicates a midline position)

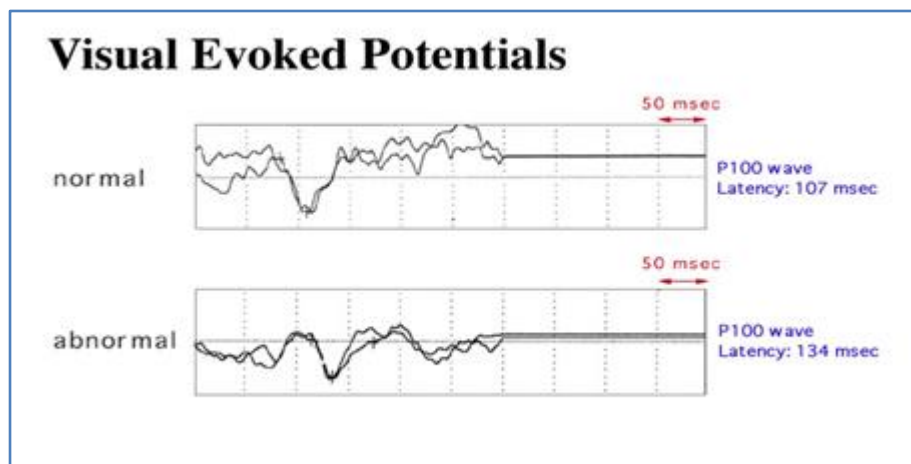


Fig. 2- Visual Evoked Potentials in a patient of Type 1 Diabetes Mellitus.

Subjects	No. of subjects	P100 Latency (Mean \pm S.D.)	P100 Amplitude (Mean \pm S.D.)
Diabetic	20	103 \pm 5.84	4.70 \pm 1.62
Controls	20	96.25 \pm 4.03	5.81 \pm 2.10

Table No. 1: Mean P₁₀₀ latencies and amplitudes in type 1 diabetic and controls

Duration of diabetes (In yrs.)	Mean \pm SD	Male	Female	Total no. of cases	Percentage
<5	2.77 \pm 1.18	5	3	8	40%
6-10	7.11 \pm 0.94	5	2	7	35%
>10	13.65 \pm 2.05	3	2	5	25%
Average Mean \pm SD	7.08 \pm 4.57	13	7	20	100%

Table No. 2: Duration of type 1 diabetes mellitus

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