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Normative Data for Peak Latencies and Amplitudes of P100 wave of Pattern Reversal Visual Evoked Potential in Central Indian Population

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ABSTRACT

Introduction: The visual evoked potentials (VEP s) is an important diagnostic tool used by neurophysiologist, ophthalmologist, neurologists and neurosurgeons as many neurological disorders present with visual abnormalities , particularly when the clinical signs and the results of neuroimaging methods are either non informative or non-conclusive. VEPs are produced by electrical activity of the visual cortex in response to light or pattern stimulation of the eye. It can detect functional loss in the visual pathway from retina to the visual cortex.

Aims and objectives: The study was planned to report the normative data for VEP P100 latencies and amplitude in normal subjects aged 40-60 years.

Methods : This study included 60 healthy subjects between the age group 40- 60 years consisting of both males and females. VEP was recorded using pattern reversal stimulation with RMS EMG MARK II machine. P100 wave latencies and amplitudes were obtained in all the subjects to determine the normative values.

Results: In our study, normal mean value of P100 latency was 98.79 $\pm$ 5.75 milliseconds and mean P100 amplitude was 7.45 $\pm$ 1.14 microvolts.

Conclusion: The normative values for P100 latencies and amplitudes of PR- VEP in normal adults of Central India have been reported in the present study. These can be used for evaluation and interpretation of various VEP abnormalities. The normal values of VEP may be affected by technical factors related to machine and environment settings in different labs. So, each health care institution should have its own reference values according to normative data for their lab for VEP to improve the accuracy of the test.

Keywords: *Normative, Pattern reversal, Visual Evoked Potential, P100 wave, latency, amplitude*

INTRODUCTION

Electrical potentials that occur in the cortex after stimulation of sense organ, which can be recorded by surface electrodes, are known as Evoked Potentials. e.g. Somatosensory Evoked Potential (SEP), Auditory brainstem response (ABR) and Visual Evoked Potential (VEP). VEPs are produced by electrical activity of the visual cortex in response to light or pattern stimulation of the eye. It can detect functional loss in the visual pathway from retina to the visual cortex.1

The visual evoked potentials is an important diagnostic tool used by neurophysiologist, ophthalmologist, neurologists and neurosurgeons as many neurological disorders present with visual abnormalities , when the clinical signs and the results of neuroimaging methods are either non informative or non-conclusive.2 Visual Evoked Potentials can

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provide important diagnostic information regarding the functional integrity of the visual system.

The VEP is very useful in detecting an abnormality in anterior visual conduction pathway .3 It is most useful in detecting optic nerve function and less useful in retrochiasmatic disorders in which , the MRI is a more useful test.4

Normal VEP: The usual waveform is the initial negative peak (N1 or N75) followed by a large positive peak (P1 or P100) and followed by another negative peak (N2 or N135). Of these, P100 is said to have the origin in the visual cortex. Clinical interpretation of PVEP is largely based on latency and amplitude of major positive peak P100. It derives its name from the fact that it occurs approximately 100 msec after the stimulus onset and is most consistent , least variable peak and reproducible waveform as compared with N75 and N 135 waves which is generated in striate and parastriate visual cortex in response to visual stimulus. It thus measures the velocity of nerve conduction and synaptic transmission.3,5 Reductions in the number of receptors, axons in the optic nerve, etc reduce the amplitude of the response while slowing of the conduction in the visual pathway produces prolongation of the latencies.5

The key purpose of the study was to assess and establish normative data for peak latencies and amplitudes of P100 wave of PR-VEP in population of central india.

AIMS AND OBJECTIVES

The study was planned to establish the normative data for VEP P100 latencies and amplitude in normal subjects aged 40-60 years.

MATERIALS AND METHOD

The study was conducted in the Neurophysiology lab in the department of Physiology, Gandhi Medical College, Bhopal. The study comprised of 60 healthy subjects within the age group 40 – 60 years, in which there were 30 males and 30 females. Approval from the institutional ethical committee was taken to carry out the research work. A complete clinical examination of each subject was done after obtaining a written informed consent and detailed clinical history.

Occular examination findings were noted which include determination of visual acuity by Snellen's chart and near vision chart, ocular movements, pupil reactions, confrontational visual field screening. Direct ophthalmoscopy was done for the initial evaluation of fundus.

Inclusion criterion

Both male and female subjects with visual acuity 6/6 with normal pupillary reactions, normal fundus and full and normal field of vision.

Exclusion criterion

Presence of any illness that could influence visual evoked potential, subjects with history of serious visual problems, any major chronic ophthalmic disease, traumatic optic nerve atrophy, multiple sclerosis, retrobulbar neuritis, glaucoma, ishaemic optic neuropathy history of major illness like diabetes, hypertension, HIV infection, hereditary and degenerative diseases, history of drug abuse and history of cerebrovascular accidents, recent eye medications with mydriatics and cyclopegics prior to the test were excluded from the study.

On the basis of detailed clinical examination, subjects were recruited for the study.

Patients were subjected to VEP test on RMS EMG EP MK-II machine in the Neurophysiology unit of Department of Physiology, Gandhi Medical College, Bhopal.

Visual Evoked Potential (VEP) Test -

Pre test evaluation - Participant preparation for PRVEP test

The subjects were advised to come without oil or any hair chemical to the scalp.

They were instructed to have an adequate sleep the previous night to prevent the effect of drowsiness on the responses.

Subjects were explained about the procedure in detail to ensure full co-operation and avoid apprehension

VEP instrumentation room set-up-

Equipment –

VEP was recorded with a pc based, two channel, RMS EMG EP MK II machine -equipped with pattern-shift stimulator television screen, signal amplifier with

filters, computer system for averaging.

VEP was performed in a specially equipped electro diagnostic procedure room, made dark and sound attenuated for the test. Subjects were seated comfortably about 100 cm away from a video monitor.

Electrodes and Electrode Placement -

Standard surface electrodes were placed according to the international 10/20 system of electrode placement **(ISCEV standards, 2009).**6

This system specifies the position of scalp electrodes as percentage of distances between definitive landmarks such as nasion, inion and ear tragus (Figure 1). The placing of the electrodes as well as the nature of PVEP testing was explained to each participant.

The recording electrodes were placed on the scalp at the following reference points:

Oz (Occipital region) = Active or recording electrode

Cz (Vertex) = Ground electrode

Fz (Frontal region or forehead) = Reference electrode

Head size measurements were taken from nasion to inion prior to the electrodes placement. To apply the electrodes, conductive electrode paste was applied on the marked electrode locations to make sure a good, stable electrical connection between the scalp and the electrodes was made. Each electrode was pressed firmly onto the scalp with the help of contact paste .Micropore gauze was placed on top of the electrodes to ensure their contact was maintained. The electrode impedance was kept below 5 kΩ.

VEP Recording-

A montage consisting of one channel (Oz-Fz) was used for VEP recording. The video- monitor presented a black and white checkerboard pattern with a fixation spot in the centre of the screen (mean luminance 50 candela/ m2 and contrast 70%). 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 checks / pattern elements reversed alternately at a rate of twice per second. The bioelectric signal was amplied (gain 20,000), filltered (band-pass, 1-100 Hz), and 150 events free from artifacts were averaged for every trial. 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). Subjects were instructed to fix the gaze on a small red coloured block at the centre of the screen of video monitor (Figure 2). Monocular stimulation was done with an eye- patch covering the other eye.

PRVEP instructions given to participants :

The participants were requested to remain comfortable and relax when viewing the checkerboard screen. They were instructed to maintain a normal blink rate to ensure a clear optical image. Also, if the subject experienced any discomfort he or she was asked to mention it. The participants were instructed to maintain their focus on the central red coloured block in the centre of the display screen.

PVEP waveform and markings --PVEP recording parameters

With the preset stimulus and recording conditions as mentioned above and keeping the electrode impedence <5 kΩ, the recording procedure was started. To verify the reproducibility of the waveform, two responses were recorded and superimposed. Trials were repeated if there was inconsistency of the response.The PVEP waveform thus obtained was used for measurements.

The waveforms were labeled for the peaks N75, P100 and N145. The latency of the response was measured from the sweep onset that corresponded to the presentation of the stimulation. The first major positive peak (P100) was measured after stimulation of each eye. The parameters taken for the study were P100 latency of the waveform measured in milliseconds (ms), and N75-P100 amplitude which is measured from the peak of N75 to the trough of P100 (N75-P100), in microvolts (μV) in both eyes.

Statistical Analysis:

The mean and standard deviation for latencies and amplitudes of VEP waves was obtained. The values were taken as VEP electrophysiological data (normal values), for our laboratory, in persons in this region.

RESULTS

Our study comprised of 60 healthy subjects between the age group of 40-60 years. The mean latency of P100 wave in normal subjects was 98.79±5.75 milliseconds. The mean P100 amplitude was 7.45±1.14 µV.

Table 1 : Normative values of PRVEP P100 latency and amplitude

Parameter	Mean	Standard Deviation
P100 latency (ms)	98.79	5.75
N75-P100 Amplitude (µV)	7.45	1.14

Table 2 : Comparative values of PRVEP P100 latency and amplitude (present study vs others' report)9-13

Author / year	Recording montage	no. of subjects	Age (years)	P100 latency(ms)	Amplitude (µV)
Celesia et al.,1987	Oz-Fz	112	20-75	98.1±4.4	9.9±5.9
Guthkelch et al.,1987	Oz-Fz	16	18-30	100.04±3.9	
O P Tandon, 1989	O1-A1 and O2-A2	27	17-35	94.25±7.14	6.53±2.44
Mishra and Kalita, 1999	Oz-Fpz	58	15-58	96.9±3.6	7.8±1.9
Jayshree P, 2008	Oz-Fz	146	1-75	97.6±2.3	6.79±3.3
Present study	Oz-Fz	60	40-60	98.79±5.75	7.45±1.14

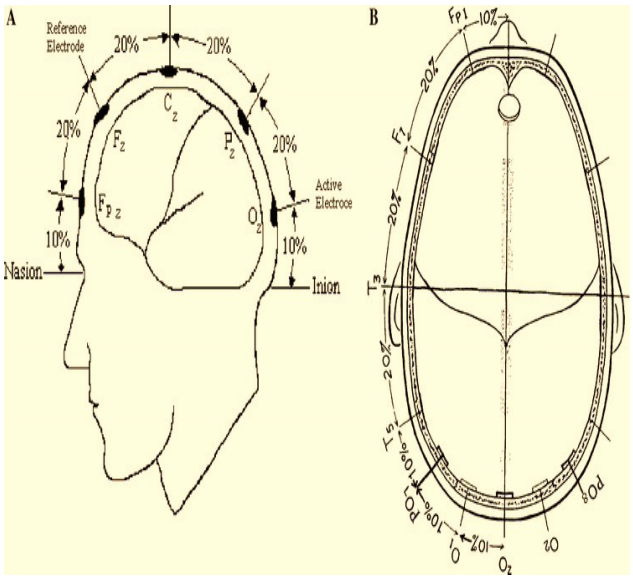

Fig. 1 : Electrode placement

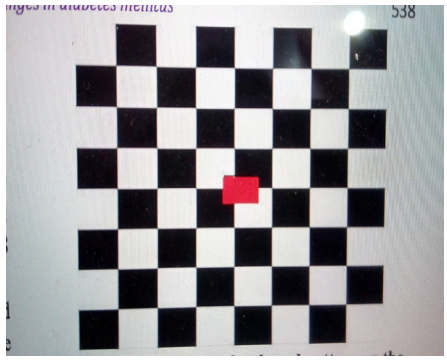

Fig. 2 : Checkerboard pattern for PR – VEP

DISCUSSION

VEP is an important diagnostic tool for evaluating visual function and is highly sensitive to lesions of the optic nerve anterior to chiasma. It is used to assess the functional integrity of visual pathway from retina upto visual cortex.

In our study, the mean latency of P100 wave in normal subjects was 98.79± 5.75 milliseconds. The mean P100 amplitude was 7.45+_1.14 µV (Table 1).

The values of P100 latencies and amplitudes in the present study are comparable to VEP studies in other

regions (Table 2). 7-11

Shibasaki H and Kurowia Y reported the mean peak latency of P100 wave as 92.5± 4.44.12 Another study done by Kamra M et al., 2014 in north indian population reported 102.5± 5.21 and 5.18± 2.11 for P100 latency and amplitude respectively.13 The value reported by Shahrokhi et al. (1978) for P100 latency was 102.3±5.1. and 10.1±4.2 for P100 amplitue.**14** In an Indian study conducted by OP Tandon, the value reported for P100 latency was 94.25± 7.14 and 6.53+ 2.44 for P100 amplitude.**9**

The primary reason for this disprepancy could be the representative population which in our study comprised of middle aged and elderly subjects and the difference in technical factors used for recording and recording instrument which differs from institute to institute. So, there is need for each institute to have its own parameters according to the device.

CONCLUSION

In conclusion, we have reported normative data on peak latencies and amplitudes of P100 waveform in central indian population that will provide baseline criterion for evaluation and interpretation of various VEP abnormalities. The values of P100 latencies and amplitudes in the present study are comparable to VEP studies done in other regions. The values are affected in relation to machine, technical factors used for recording and environmental settings in different laboratory. Each neurophysiological laboratory doing VEP studies should have its own normative values for reference to facilitate clinical interpretation.

Conflicts of Interest: None

Source of Funding: None

Ethical Issue: None

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