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Research Article

Normative Data for Pattern Reversal Visual Evoked Potentials in Population of North India

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Abstract

Aim: The Visual Evoked Potentials (VEPs) result from change of brain activity following application of intermittent visual stimulus to the visual system. They provide a quantitative measure of the functional integrity of the visual pathways. The function measured includes that of the optic nerve, through the optic chiasma and the tract, to the lateral geniculate bodies and the geniculocalcarine projection to the visual cortex. VEP can help us to find out neural path anamoly/abnormality from retina to calcarine fissure. There is need to have normative values for VEPs in local population for interpretation of any clinical abnormality. This study was planned for healthy population of north India to establish the normative data for VEP latencies and the amplitude in normal subjects aged 20-50 yrs. **Method:** The study comprised of 210 healthy subjects between the age group of 20-50 years consisting of both males and females. Visual Evoked potential was recorded using pattern reversal stimulation using standardised methodology in accordance with International Federation of Clinical Neurophysiology (IFCN). **Results and conclusion**: Normal mean value of N75 latency was 68.96±5.66 ms, P100 latency was 102.50±5.21 ms, N145 latency was 145.06±11.95 ms and P100 amplitude was 5.18±2.11µv in our study. We established normal VEP values in age group of 20-50 years using Allengers Scorpio EMG EP NCS system at Maharishi Markandeshwar Institute of Medical Sciences and Research to distinguish between normal and pathological patients. The values are affected in relation to machine and environmental setting in different laboratory. It is essential for individual laboratories to set their own normal values.

Keywords: pattern reversal, P100 latency, P100 Amplitude, Visual Evoked Potentials (VEPs)

Introduction

Vision is an inherently subjective phenomenon that is at once the most complex and the most treasured of human sensations. Certain aspects of vision have been explored by objective means such as studies of photochemical changes in the retina, and electrophysiological responses at various points in the visual pathways.

Evoked potentials are the record of electrical activity produced by groups of neurons with in the spinal cord, brainstem, thalamus or clinical hemispheres following stimulation of one or another system by means of visual, auditory or somatosensory input (Chiappa et al., 1987).They are the voltage changes generated in the brain, the sense organ and the pathway leading to the brain in response to an external stimulus (auditory,visual) e.g. Brainstem Auditory Evoked potentials and Visual Evoked Potentials. Visual Evoked Potentials is of immense clinical utility. The Visual Evoked Potentials (VEPs) result from change of brain activity following application of intermittent visual

stimulus to the visual system. They provide a quantitative measure of the functional integrity of the visual pathways (Kothari et al., 2012). The function measured includes that of the optic nerve through the optic chiasma and the tract, to the lateral geniculate bodies and the geniculocalcarine projection to the visual cortex "area 17" (Celesia, 1988).

Vision is appreciated by contrasting the point focussed with the background. If the background is focussed than the point of earlier focus becomes less discrete. This reversal of focus of the object versus background is likely to have an imprint on the Visual Evoked Potentials. This technique of VEP recording is pattern reversal and is the preferred stimulus.

In VEP responses NPN waveform complex is formed. It has 3 components N75, P100, N145 latencies in msec. In addition to them we can determine the P100 waveform amplitude in µv, inter-ocular latency difference and amplitude difference. Increase in the latency of P100 wave in ms determines diagnosis of various disorders of the visual pathway in the brain.

The N75 component of the pattern reversal VEP originates from the primary visual cortex. The origin of the P100 component occurs from the striate cortex in occipital lobe (area 17). N145 component arises from the calcarine cortex or from both striate and extra striate areas. Pattern reversal VEPs are less variable in waveform and timing than VEPs elicited by other stimuli.

The VEP is very useful in detecting an anterior visual conduction disturbance (Halliday et al., 1976). It is not specific with regard to etiology. For example a tumor compressing the optic nerve, an ischemic disturbance, or a demyelinating disease may cause delay in the P100. VEPs are most useful in testing optic nerve function and less useful in retrochiasmatic disorders. In retrochiasmatic lesions, the MRI is a more useful test (Leslie et al., 2002).

Clinical usefulness of VEPs includes:

- VEPs are more sensitive than MRI.
- VEPs are objective and reproducible test for optic nerve function.
- VEPs are useful in cases where abnormality persists over long periods of time.
- VEPs are less expensive as compared to MRI.
- Under certain circumstances, it is helpful to positively establish optic nerve function in patients with subjective complaint of visual loss. A normal VEP excludes significant optic nerve or anterior chiasmatic lesion.

VEP can help us to find out neural path anamoly/abnormality from retina to calcarine fissure. There is need to have normative values for VEPs in local population for interpretation of any clinical abnormality. This study was planned for healthy population of north India to establish the normative data for VEPs. With this study we sought to contribute to assess the importance of VEP for clinical examinations of individual subjects.

Material and Method:

The study was conducted in the department of Physiology, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana (Ambala). Institutional ethics committee approval had been taken.
The study was comprised of 210 healthy subjects between the age group of 20-50 yearrs in an around consisting of both males and females.

Informed written consent was taken from volunteers. Anthropometric data i.e. age, height, weight was noted and they was screened for any history of drug intake or medical illness which are likely to affect the VEP study parameters based on clinical history and physical examinations including detail optic assessment.

Inclusion Criteria:

• Best-corrected visual acuity 6/6 (with or without corrective glasses).
• Full and Normal field of vision
• Normal optic nerve head and retinal nerve fibre layer on clinical examination
• Normal pupillary size (2-4mm) and reactions
• Normal Fundus and optic disc

Excluding Criteria:

1. Multiple sclerosis
2. Glaucoma
3. Ischaemic optic neuropathy
4. Optic neuritis
5. HIV infection
6. Vitamin B_{12} deficiency
7. Nutritional and Toxic optic neuropathy
8. Hereditary and Degenerative diseases
9. Compressive lesions affecting anterior visual pathways
10. Cortical blindness

11. Diabetes mellitus
12. Malingering and Hysteria

Pre-test evaluation

For obtaining the best result of VEP testing, subjects were advised to come without applying any hair oil or hair chemicals and to put their usual glasses or corrective lenses. Subjects were explained about the test to ensure full cooperation and to avoid subject's inattention and defocusing during the test procedure.

Recording Procedure

The equipment used was Allengers Scorpio EMG EP NCS system provided by Allengers Medical system Limited, Chandigarh. VEP was evaluated by voltage changes generated following application of pattern reversal visual stimulus to the visual system.

Skin electrodes (EP disk electrodes) were used. Skin was prepared by cleaning and paste (conduction paste) used to ensure good, stable electrical connection.

The electrodes on scalp were placed relative to bony landmarks as per international 10/20 system. The anterior/posterior midline measurements were based on distance between nasion and inion.

For visual evoked potential study, electrode placement was-

1. Reference- placed on frontal bone (F_{pz}).
2. Ground- placed on vertex(C_z).
3. Active (recording)- placed on 2-4 cm above the inion, on the scalp over visual cortex(O_z) (Figure 1).

Pattern stimuli:

The standard pattern stimulus is high contrast black and white checkerboard. The viewing distance (typically between 50-150 cms) to be adjusted to get a suitable field size and required check sizes. For pattern reversal protocol black and white check changes phase abruptly (black to white and white to black). A reversal rate of a reversal per second was used to elicit standard pattern reversal VEP (each full circle consists of two reversals which equates to a frequency of 1.0 Hz). The stimulus rate, the number of reversals, the mean luminance, the pattern contrast and field size was specified.

- The rate of pattern reversal was 1 Hz.
- The recording sensitivity was kept at 2μV
- The electrode impedance was kept below 5KΩ.

Following parameters were recorded. They were-

1. Latency for P_{100} wave in mill sec (ms).
2. Latency for N_{75} wave in mill sec (ms).
3. Amplitude of P_{100} wave in microvolt(μv).

Statistical Method

The values were statistically analysed and result expressed as mean±SD. The values were taken as electrophysiological data (normal values) in adults of this region.

Result and Analysis

Our study comprised of 210 healthy subjects between the age group of 20-50 years in and around consisting of both males and females. . Descriptive statistics (Mean±SD) of various latencies of VEP and amplitude of P-100 wave of both eyes are shown in [Table I].

Discussion

Visual Evoked Potential [VEP] is the signal elicited by visual stimuli. They are recorded with cutaneous electrodes placed on the scalp in the occipital region. It is the electro-physiologic test that assesses visual cortical activity. The standard for VEP recording has been established by the ISCEV.

In our laboratory we used skin electrodes in VEP recordings. The equipment used was Allengers Scorpio EMG EP NCS system provided by Allengers Medical system Limited, Chandigarh. VEP was evaluated by voltage changes generated following application of pattern reversal visual stimulus to the visual system.
Our study comprised of 210 subjects in the age group of 20-50 years to collect the normative data for the VEP containing equal number of males and females.

As shown in Table 1, the mean N75 latency is 68.96±5.66ms. The minimum N75 latency is 59.40 ms and maximum N75 latency is 87.50 ms. The mean P100 wave latency is 102.50±5.21ms. The minimum P100 latency is 90.05ms and the maximum P100 latency is 122.70ms. The mean N145 latency is 145.06±11.95ms. The minimum N145 latency is 120.0ms and the maximum is172.60ms. The mean P100 wave amplitude is 5.18±2.11μv. The minimum P100 wave amplitude is 1.79μv and the maximum is12.41μv. It also shows the percentile distribution of these measures.

Earlier the same normative study of VEP is done by Dr. Lakshminarayanappa D.C. in 2010 in Bangalore.

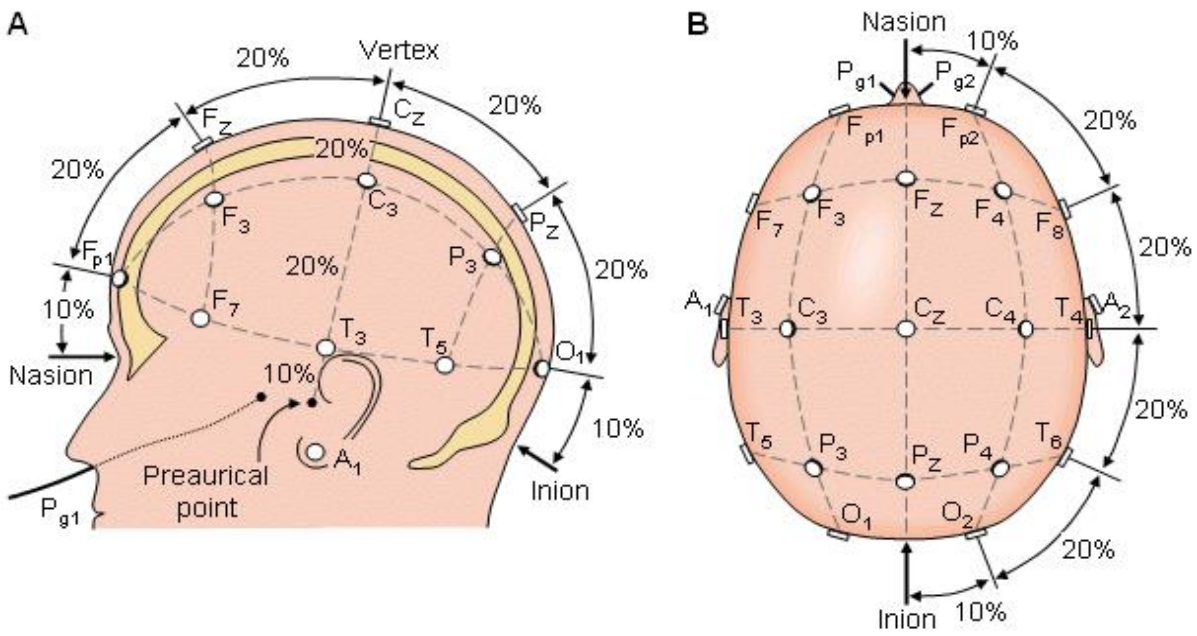

Figure 1. Electrode Placement

Table-1: Normative data in the form of mean±SD of N75, P100, N145 latencies in ms and P100 waveform amplitude in µv.

		N75(ms)	P100(ms)	N145(ms)	P100(µv)
Mean		68.96	102.50	145.06	5.18
Std. Deviation		5.66	5.21	11.95	2.11
Minimum		59.40	90.05	120.00	1.79
Maximum		87.50	122.70	172.60	12.41
Percentiles	**5**	60.00	94.31	128.03	2.33
	25	64.91	98.93	136.03	3.50
	50	68.55	102.07	143.65	4.85
	75	72.30	105.40	154.25	6.61
	95	78.57	111.67	165.27	9.22

The results showed latency of Left N70 with a minimum value of 56.25 ms & a maximum value of 81.25 ms with a mean value of 62.97 ± 4.98. Right N70 showed a minimum value of 56.25 ms & a maximum value of 80.63 ms with a mean value of 63.09 ± 5.22. Left P100 showed a minimum value of 80 ms & a maximum value of 105 ms with a mean value of 85.65 ± 7.85. Right P100 showed a minimum value of 80 ms & a maximum value of 104.38 ms with a mean value of 86.26 ± 8.11 Left N155 showed a minimum value of 123.75 ms & a maximum value of 180.60 ms with a mean value of 151.04± 15.40. Right N155 showed a minimum value of 123.75 ms & a maximum value of 184.40 ms with a mean value of 155. ±18. In one more earlier study done by Tandon et al showed P100 latency of 95.3±6.8 msec.

Conclusion

The VEP responses are variable among persons, group of age, difference laboratory and techniques. Each laboratory should obtain their normal values and age-related normative values for VEP test to facilitate clinical interpretation. It will help or support the diagnosis for the clinician only when correlate with complete ocular examination.

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