

Do Mental Arithmetic Tasks affect Visual Evoked Potential?

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Abstracts

Background & Objectives- VEP is used to evaluate functional integrity of visual pathway. Objective of study is to see that stimulus other than light, during recording of VEP, can change the result of VEP.

Method- 200 healthy candidates of age between 18yrs -22yrs of both sexes were enrolled. At first, recording of VEP was done without any disturbance. Candidates were asked few arithmetic tasks verbally while recording VEP for second time.

Results- Analysis of latency of N75, P100 and amplitude of N75-P100 was done. There was no statistical significant difference in latency of N75 and P100 but there was significant statistical difference in amplitude of N75-P100. The p-Value for right eye is 0.0031 and for left eye 0.0299 for amplitude of N75-P100.

Interpretation & conclusion-Arithmetic task makes mental processing very active and it affects the result of VEP thus it must be taken in to consideration while recording of VEP in any patient.

Keywords: VEP, Latency N75, Latency P100, Amplitude of N75-P100 Arithmetic tasks.

Introduction

Visual evoked potentials are visually evoked electrophysiological signals extracted from electroencephalographic activity in the visual cortex recorded from the overlying scalp. As visual cortex is activated primarily by the central visual field, VEPs depend on functional integrity of central vision at any level of the visual pathways including the eye, retina, the optic nerve, optic radiations and occipital cortex.¹

Visual evoked potentials (VEPs) are used to interrogate the visual pathway from the retina up through high-level visual cortices.²

Preliminary experiments show that these fluctuations in evoked potentials depend on movement of the eye and eyelid, intensity of the flashes and mental state as indicated by flash counting (attention), conversation

(distraction), and mental arithmetic (problem solving) among other factors.³

Attention to the evoking stimulus tends to result in increased amplitude and decreased latencies but while distraction due to assigned task or another stimulus produces the opposite results⁴ Significant effects were seen with field strength and scalp topography when subjects were actively processed with stimuli. Processing anagrams was accompanied by larger field strength than mental arithmetic.⁵

During VEP recording with use of LED goggles patient is able to hear the various sounds around him along with visual stimulation. Objective of study is to evaluate the effect of auditory mental arithmetic task while recording VEP in healthy subjects. Stimulus other than light, during recording of VEP, can change the result of VEP.

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Material and Method

A This study was carried out in the Department of Physiology (Neurophysiology laboratory) in L.N.Medical College and Research Center, Bhopal. 200

healthy candidates of age between 18yrs -22yrs of both sexes were enrolled after fulfilling exclusion criteria, for study after approval from Institutional Ethical committee.

Exclusion criteria for selection of the candidates were:-

- H/O eye surgery
- Color-blindness.
- H/O seizures.
- Candidates on anti-depressants.

Pre-requisites –

- Candidates should make hairs oil free before test.
- To take good sleep and normal meal.
- To remove contact lenses during procedure.

Device used for recording of VEP -EMG Octopus by Clarity Medical Private Limited ISO9001 & ISO13485.

Technical setting for recording of VEP used was-

Channels –

- Active – Mid-Occiput - Oz.
- Reference – Mid Frontal - Fz.
- Ground – On hair line of fore-head - Cz.

Band Pass –

- Low filter = 2Hz.
- High Filter = 200 Hz.

Number of epochs given = 200.

Rate of stimulation was 2Hz.

After fulfilling exclusion criteria and history and he/she was asked to sit on a comfortable chair facing in opposite direction from the recording monitor. Candidate was well informed about the procedure. Electrodes were placed with the gel over the positions mentioned above as per 10-20 system after cleaning the area before hand. LED goggle has been worn to the candidate and impedance check was done which was maintained below 5K Ω . Collection of data done by stimulation the right eye first then left eye at above mentioned rate and epochs as basic recording with visual stimulus only. After half hour interval recordings for both eyes were repeated one by one. During this recording after 50 epochs arithmetic tasks were asked to each candidate to solve along with the continuation of visual stimulus and it continued up to 200 epochs of visual stimuli. Analysis of recorded data

has been done by using Graph Pad online calculator and tables and graph with help of Microsoft office and excel worksheet.

Various arithmetic tasks which were asked to the candidates are as follows –

12 \times 8, 11 \times 7, 9 \times 8, 17 \times 6, 19 \times 5, 22 \times 4 etc

Result

Data collected and analysed for Latency of N75 and P100 and amplitude of N75-P100. Paired t-test applied for analysis. Results of all parameters are as tables given below.

Table no -1 Latency of N75 (ms)

(n=200)

	At rest		During arithmetic task		p-value
	Mean	SD	Mean	SD	
Right eye	63.851	11.915	63.739	10.616	0.9246
Left eye	66.9885	13.6046	67.3088	12.7705	0.7845

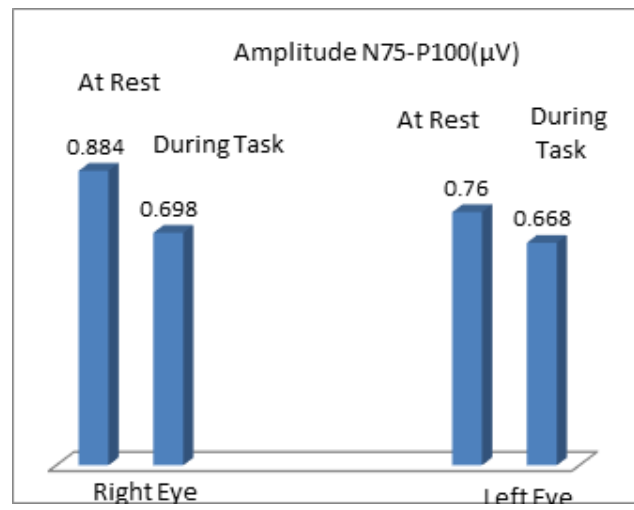
Table no -2 Latency of P100 (ms)

(n=200)

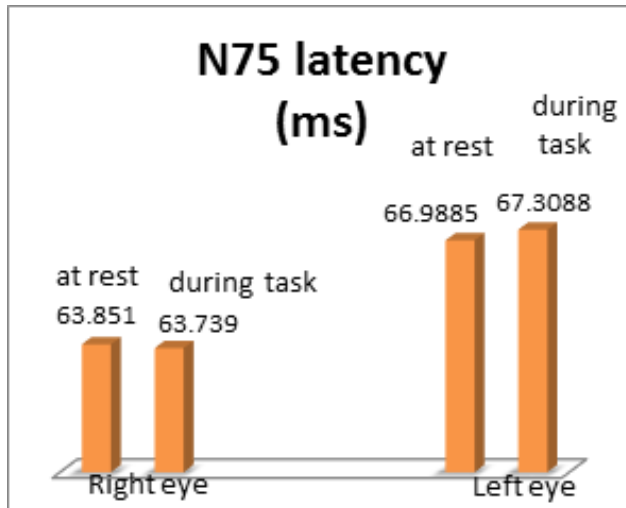
	At rest		During arithmetic task		p-value
	Mean	SD	Mean	SD	
Right eye	86.798	14.157	86.026	14.720	0.6024
Left eye	90.168	18.428	88.817	17.640	0.4388

Table no -3 Amplitude of N75-P100 (μ V) (n=200)

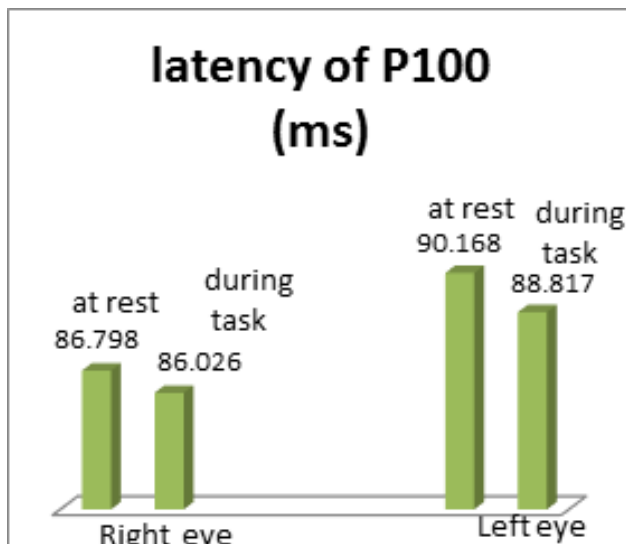
	At rest		During arithmetic task		p-value
	Mean	SD	Mean	SD	
Right eye	0.884	0.754	0.775	0.698	0.0031
Left eye	0.760	0.524	0.668	0.626	0.0299



Graph-3



Graph -1.



Graph-2

Discussion

Latencies of N75 and P100 for both eyes have not shown any statistical significant difference between the recordings, at rest and during auditory arithmetic task.

But in case of amplitude of N75-P100 has shown significant statistical difference comparing both recordings. During arithmetic task was amplitude decreased showing change in mental state and activation of area of brain related to this task and decreasing attention towards visual stimulus. This result also shows that in population right eye dominant persons are more thus p-value is giving more significant result for right eye then left eye. Charls T Ramussen et al has given the same finding while assessing cortical evoked potential as a function of arithmetic computation that there was no shift of latency while doing experiment. They had also shown that there were differences in amplitude while performing the task.⁴

In a study of topography of evoked brain activity during mental arithmetic and language task has shown that there was difference in amplitude and latency⁵

Numerical working memory ability is proved to be associated with centro-parietal area of the brain and change in amplitude of the wave evoked from this area had shown while doing visual evoked related potentials.⁷

Conclusion

Result of study had shown that active mental processing cannot change the latency significantly but there is significant change in amplitude of N75-P100 while ongoing task. Emphasis is done on that while

recording VEP subject or patient should be in complete mental and physical rest otherwise there may be wrong interpretation of VEP and it may give wrong diagnosis.

In future this type of studies can be done in different age group subjects as well as patients.

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References

1. ISCEV standard guideline.
2. Seki K, Nakasato N, Fujita S, Hatanaka K, Kawamura T, Kanno A, Yoshimoto T. Neuromagnetic evidence that the P100 component of the pattern reversal visual evoked response originates in the bottom of the calcarine fissure. *Electroencephalogr Clin Neurophysiol* . 1996;100: 436-442.
3. Collura T.F. and Lorig R.J. Real time filtering of transient Visual evoked potential. 30th ACEMP; Nov 1977:5-9.
4. Rasmussen Charls T, Allen Roy and Tarte Robert D. Hemispheric asymmetries in the cortical evoked potential as a function of arithmetic computations. *Bulletin of the Psychonomic Society*, 1977; 10(5):419-421.
5. S Karnidies W, Reik P, Kunze C. Topography of evoked brain activity during mental arithmetic and language tasks: Sex difference. *Neurophysiologia*. 1999 Apr; 37(4):412-30.
6. Seiple W, Holopigiank, Clemens C. The multifocal Visual evoked potential : an objective measure of Visual field?. *Vision Research*. 2005 Apr; 45(9):1155-63.
7. Yue C, Sun X, Liu Z. Comparison of visual evoked related potentials in healthy young adults of different COMT genotypes by using a 3-back paradigm during a continuous arithmetic task. *Sheng Wu Yi Xue Gong Cheng Xue Zazhi*. 2008 Jun; 25 (3):562-6.
8. Severens M, Farquhar J. Brain- computer interface: Use of transient and steady state responses. *Journal of Neural Engineering*. 2013;10(2).