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VISUAL EVOKED POTENTIALS IN COPD

Physiology

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ABSTRACT

Aims and objectives: To evaluate the effect of COPD on Visual Evoked Potential wave latencies and amplitude.

Methods and Material: The study was conducted in the department of Physiology, MMIMSR, MMU, Mullana (Ambala). The study comprised of 100 subjects divided in two groups. Group-1 contains 50 normal healthy subjects. Group-2 contains 50 COPD patients both males and females.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. Pulmonary function test was performed to all the subjects. The parameters assessed were FVC, FEV1 and FEV1/FVC ratio by using computerized, Helios software. Unpaired T-test was used to evaluate the statistical value.

Results and conclusions: In our study VEP wave latencies i.e N75 wave, P100 wave, N145 wave latencies and P100 wave amplitude in COPD patients were prolonged highly significantally in both eyes with P value less than .0001 and less than .03 respectively.

KEYWORDS

VEP, COPD, Visual Evoked Potential,P100

Introduction:

Evoked potentials are the record of electrical activity produced by groups of neurons with in the spinal cord, brainstem, thalamus or cortical hemispheres following stimulation of one or another system by means of visual, auditory or somatosensory input[1]. 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 [2]. 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"[3].

Vision is appreciated by contrasting the point focussed with the background. 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[4]. 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.

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.

COPD is characterized by progressive pulmonary airway obstruction. It leads to the persistent airflow limitation in the airway. COPD is major health problem worldwide. The symptoms of COPD get enhanced by bacterial and viral infection and other environmental factors. COPD is 4TH leading cause of death in the world[5]. It will be the 3rd leading cause of death by 2030. More than 3 million people died because of COPD in 2012. Globally, the COPD burden is increasing in coming decades due to increased exposure to COPD risk factors and aging of the population[6].

Various cardiovascular, neurological and metablic disorders are associated with COPD. COPD leads to physiological alterations like anxiety and depression[7].many studies have shown peipheral neuropathy as an extrapulmonary menifestation of COPD[8,9]. many COPD patients suffer with neuropathy subclinically. This neuropathy is correlated with cigarette smoking[10]. Hypoxia develops with advancement of COPD. Visual receptors are affected from hypoxia[11]. In visual system perceived brightness, acuity and dark adaptation are more affected by the hypoxia[12,13].

COPD may cause retinal and optic nerve damage[14]. High prevalence of COPD may lead to non arteritic anterior ischaemic optic neuropathy in middle aged people[15]. Visual acuity and other ocular tests commonly employed during clinical assessment of optic nerve. They cannot detect changes of neuropathy before the appearance of symptoms. VEP is a sensitive tool which detects subclinical visual impairments.

COPD is known to cause hypoxia, hypercarbia and acidosis which are potential risk factors for polyneuropathy[16]. A few studies have recorded abnormal VEPs in COPD cases. The result of these workers is based on small sample size. It justifies that a sample of 100 subjects of both sexes for study of VEPs in COPD patient are important to assess the risk on visual pathways and optic neuropathy.

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 was taken.

The study comprised of 100 healthy subject divided into 2 groups.
1. Control group
2. Study group

Each group consisted of 50 subjects containing both males and females with age group 35-60 years.

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:

All the subjects underwent thorough eye check-up to exclude any eye pathology. The visual acuity and colour vision are being tested and those who are having normal colour vision and 6/6 acuity (with or without glasses) were included in the study.

Acuity of vision assessed as follows:
Near vision- Jaeger's Chart
Distant vision- Snellen's Chart
Colour vision- Ishihara's Chart
Visual field- Perimetry

Pulmonary funtion tests were performed to all the subjects. Lung volumes and capacities determined by spirometry. The parameters assessed were FVC, FEV1 and FEV1/FVC ratio with the help of computerized, Helios software

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

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} in ms.
- 2.Latency for N_{75} in ms.
- 3.Latency for N145 in ms
- 4.Amplitude of P_{100}in µv.

Statistical Method:
Unpaired T-test was done to evaluate the statistiacl value of the data . Data is expressed as mean ± standard deviation.

Results and Analysis:
Our study consisted of 100 subjects containing both males and females of age group 35-60 yrs. Subjects were divided into 2 groups- control and study group. PFT values of both groups with p-values are shown in table-1. Various VEP latencies i.e. N75 , P100, N145 wave latencies in ms and P100 wave amplitude in µv of both eyes in both groups are shown in table-2,3.

	FVC(%)	FEV_1 (%)	FEV1/FVC(%)
Normal (50)	79.24±9.51	85.6±8.7	89.22±6.3
COPD (50)	52.86±12.95	32.92±9.07	62.48±9.42
p-value	<.0001	<.0001	<.0001

Table-1: showing comparison of PFT values in control and study group

	N75(ms)	P100(ms)	N145(ms)	P100(µv)
left	67.99±4.53	99.07±3.4	141.31±11.41	5.01±2
right	67.62±5.77	99.41±3.35	142.56±12.63	4.74±1.82

Table-2 showing VEP values in control group

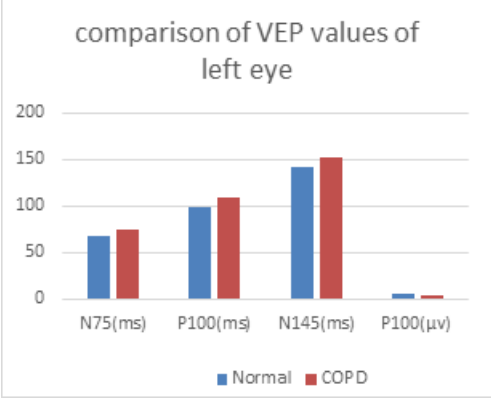
	N75(ms)	P100(ms)	N145(ms)	P100(µv)
left	74.51±9.39	108.69±6.38	151.66±15.86	4.03±2.44
right	73.69±9.02	109.82±6.13	154.56±13.97	4.52±2.84

Table-3 showing VEP values in study group
In our study PFT values i.e. FVC, FEV1, FEV1/FVC ratio are decreased in COPD patients as compared to normal subjects highly significantly with p-value less than .0001.

In our study VEP values i.e P100, N75, N145 wave latencies in ms are prolonged significantally in COPD subjects as compared to normal subjects with p value lesser than .0001. P100 wave amplitude in µv is decreased significantly in left eye with p-value .03 in COPD subjects.

Discussion:
Visual Evoked Potentials [VEPs] are 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. In our study VEP latencies are prolonged highly significantly with p-value less than .0001 in COPD patients and amplitude of left eye is decreased significantly in COPD patient with p-value .03 as shown in Fig-1 and Fig-2.

Fig-1: comparison of VEP values in left eye



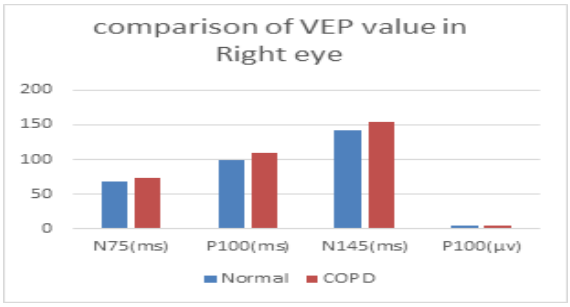


Fig-2: comparison of VEP values in Right eye

Our results correlates with the studies done by Ozge et al. [17]; Sohmer et al.[18]; and Gunn et al. [19]]. The prolongation P100 wave latency and reduction in its amplitude in COPD occurs due to hypoxaemia and acidosis which further leads to the optic nerve damage by harming vaso-nervosum. This damage leads to neuronal hyperpolarization and decreased excitability. On the contrary, P100 wave latency and amplitude was unaltered in COPD patients in studies done by Gupta et al. [20] and Demir et al. [14].

Conclusion:

In our study VEP values i.e P100, N75, N145 wave latencies in ms are prolonged significantally in COPD subjects as compared to normal subjects with p value lesser than .0001. P100 wave amplitude in µv is decreased significantly in left eye with p-value .03 in COPD subjects. These results show the demyelinating type of changes in optic nerve due to hypoxia caused by the COPD.

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