VISUAL EVOKED POTENTIAL CHANGES IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Aim: The normal visual evoked potential (VEP) reflects the functional integrity of the visual pathways from retinal to occipital striate area. Visual reseptors are sensitive to hypoxemia. Chronic obstructive pulmonary disease (COPD) is a progressive disease, in which hypoxemia occurs due to ventilation-perfusion imbalance. We aimed to evaluate the effects of COPD on VEPs.

Methods: Thirty eight COPD patients and 17 healthy control subjects were accepted to the study. Pulmonary function tests were performed to all the participants. VEP of all participants were recorded.

Results: P1 (P100) values of both right and left eyes (p=0.008 and p=0.010, respectively) and N2 value of right eye (p=0.030) were significantly higher in COPD patients than the control group. As there was just 1 female COPD patient, the measurements were re-evaluated for just male subjects. P1 values of both right and left eyes were significantly higher in male COPD patients than male control subjects (p=0.031 and p=0.023, respectively).

Conclusion: VEPs, particularly P1 value, alters in COPD patients. This change in VEPs was thought to be due to hypoxemia caused by ventilation-perfusion imbalance in COPD.

Key words:COPD, VEP, hypoxemia

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a progressive disease, which is mainly caused by hazardous dusts and particles, particularly smoking, and other environmental and personal risk factors, and presents with partially reversible airway obstruction and air flow limitation. When genetically succeptible individuals expose to these risk factors for a long duration and at high doses, chronic inflammation occurs and clinical, physiological and pathological changes of chronic bronchitis and/or emphysema develops (1).

COPD is one of the major causes of chronic respiratory failure. As the disease advances, hypoxemia develops as a result of ventilation/perfusion imbalance, decreased diffusion capasity and alveolar hypoventilation (2,3). Hypoxemia augments particularly in the exacerbation periods of the disease. When arterial partial oxygen pressure (PaO2) falls below 60 mmHg tissue hypoxia occurs and this causes systemic effects. Visual and auditory reseptors are affected from hypoxia (4,5). The visual system in human including perceived brightness, acuity and dark adaptation is sensitive to hypoxia (6,7). The normal visual evoked potential (VEP) reflects the functional integrity of the visual pathways from retinal to occipital striate area. The VEP in an adult individual consists of three negative and three positive waves within a span of 350 msec after the application of the stimulus. Out of the first three waves, N1 (N75), P1 (P100) and N2 (N145) of NPN complex, the latency and amplitude of P1 is clinically important (8). An increase in VEP latency clinically means a degeneration in the quality of sight.

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Table 1. VEP measurement results among all patients and control subjects

	COPD*	Control*	p
P1 right	108.3 ± 8.4	101.8 ± 7.0	0.008
P1 left	107.8 ± 7.7	101.7 ± 7.9	0.010
N1 right	79.0 ± 9.9	78.3 ± 9.5	0.823
N1 left	77.5 ± 9.5	75.2 ± 10.4	0.434
N2 right	141.1 ± 10.3	134.1 ± 11.7	0.030
N2 left	143.4 ± 21.2	136.0 ± 12.7	0.192
Amplitude N1-P1 right	7.0 ± 3.1	8.6 ± 3.5	0.090
Amplitude N1-P1 left	7.1 ± 3.0	8.4 ± 3.1	0.131

**Data were expressed as mean ± standart deviation*

VEP values were evaluated in various diseases (9-11). However, to our knowledge, there is no study evaluating the effects of COPD on VEPs. In this study, we aimed to evaluate the changes in VEP in patients with COPD.

MATERIALS AND METHODS

The study was approved by the Medical Ethics Committee of Kocatepe University, School of Medicine. Thirty eight COPD patients (37 male and 1 female) and 17 healthy volunteer subjects (9 male and 8 female) were accepted to the study. All participants were informed about the study and their written consents were obtained.

The diagnosis of COPD was assessed according to the criteria of Global Initiative for Chronic Obstructive Lung Disease (GOLD) (12). Pulmonary funtion tests were performed to all the participants. All the subjects have undergone thorough eye check up to exclude any eye pathology. The visual acuity and colour vision were tested and those having normal colour vision and 6/6 acuity (with or without glasses) were included in the study.

A Nihon Kohden EMG instrument (Neuropack Σ-MEB-2200, Nihon Kohden Corporation, Tokyo, Japan) was used for VEP studies. Electrodes were attached at the vertex (Cz) and Oz. The ground electrode was placed at FPz. The input impedance was kept below 5 K Ohms. Each subject was seated comfortably on a chair in a quiet darkened room 100 cm away from the screen and instructed to fix his one eye on a small white square at the centre of the screen while the other eye was fully covered with eye patch. The screen (field) size measured 11 inch vertically and 14 inch horizontally at the subject's eye and the check was 6.31 right to left. A black and white chequered board was generated by an electronic pattern generator of the Nihon Kohden evoked potential recorder. The rate of pattern reversal was 2 Hz and an average of 200 responses was recorded. At least two trials were always obtained to ensure reproducibility of the VEP pattern. The absolute latencies and amplitude of positive and negative waves were recorded.

Statistical Analysis

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) ver. 13 program. Chi-square and independent t-tests were used to compare variables. Data were expressed as mean ± standart deviation. A p value less than 0.05 was considered as statistically significant.

RESULTS

Of the 38 COPD patients 37 (97.4%) were males and 1 (2.6%) was female. Of the 17 control subjects 9 (52.9%) were males and 8 (47.1%) were females. There was a

Table 2. VEP measurement results among male COPD patients and male control subjects

	COPD*	Control*	p
P1 right	108.8 ± 7.9	102.3 ± 7.1	0.031
P1 left	108.2 ± 7.5	101.6 ± 7.1	0.023
N1 right	79.5 ± 9.4	81.5 ± 12.1	0.597
N1 left	78.1 ± 8.5	76.7 ± 14.0	0.694
N2 right	141.5 ± 10.1	139.4 ± 7.2	0.553
N2 left	143.2 ± 21.5	139.9 ± 8.0	0.652
Amplitude N1-P1 right	7.1 ± 3.1	7.1 ± 0.9	0.933
Amplitude N1-P1 left	7.1 ± 3.0	6.9 ± 1.1	0.710

**Data were expressed as mean ± standart deviation*

Table 3. VEP measurement results between smoker and non-smoker COPD patients

	Smoker*	Non-smoker*	p
P1 right	108.1 ± 8.1	108.3 ± 9.4	0.952
P1 left	107.6 ± 8.8	107.8 ± 7.1	0.947
N1 right	79.2 ± 11.0	78.6 ± 9.2	0.869
N1 left	77.2 ± 7.6	77.3 ± 11.1	0.985
N2 right	139.2 ± 10.7	142.3 ± 10.3	0.385
N2 left	138.7 ± 9.0	148.3 ± 29.5	0.196
Amplitude N1-P1 right	6.9 ± 2.4	6.7 ± 3.4	0.818
Amplitude N1-P1 left	7.0 ± 2.7	7.0 ± 3.2	0.959

**Data were expressed as mean ± standart deviation*

significant difference between the groups according to gender ($p<0.001$). Mean age of 38 COPD patients was 62.1±9.9 (44-78) and mean age of control group was 58.8±10.5 (41-76) ($p=0.259$). Mean age of male COPD patients was 61.7±9.6 (44-78) and mean age of male control subjects was 61.4±9.0 (50-75) ($p=0.944$).

When VEP measurements were evaluated it was seen that P1 values of both right and left eyes ($p=0.008$ and $p=0.010$, respectively) and N2 value of right eye ($p=0.030$) were significantly higher in COPD patients than the control group. There were no significant differences for the other measured parameters between the groups (Table 1). As there was just 1 female COPD patient, the measurements were re-evaluated for just male subjects. P1 values of both right and left eyes were significantly higher in male COPD patients than male control subjects ($p=0.031$ and $p=0.023$, respectively). There were no significant differences for the other measured parameters between the groups (Table 2).

VEP measurements were also evaluated according to the smoking status of the COPD patients. There were no significant difference for any of the parameters between smoker and non-smoker COPD patients (Table 3).

We classified P1 values into two groups as $P1\leq100$ and $P1>100$. When we compared COPD patients and control group according to this classification, we found that COPD patients had significantly higher rates for $P1>100$. There was no correlations between FEV1 value of the COPD patients and the measured VEP parameters.

DISCUSSION

The results of this study indicate that P1 values increase significantly in COPD patients. The typical normal pattern of VEP in an adult individual consists of three negative and three positive waves within a span of 350 msec after application of stimulus. Of these, first three waves N1, P1 and N2 (NPN) complex is important clinically (8). The pattern of VEPs and magnetoencephalographic studies have shown that waves N1 and P1 are mainly generated in the striate, whereas wave N2 is generated in the extrastriate visual cortex (13,14) and hence reflects functional integrated visual pathway from retina to occipital striate area. Studies show that human vision is sensitive to hypoxia. Mc Farland (6) reported that human vision is extremely sensitive to hypoxia and changes in visual functioning can be detected at altitude, above 3000 m. Fowler et al (4) suggested that hypoxia affects the pre-processing stage and there is a relatively small or no effect on the identification stage and on the response choice stage. In these studies, hypoxia was produced by breathing low oxygen mixture that produced arterial oxygen saturation ranging between 64 to 66 per cent.

COPD is major cause of respiratory failure. As the disease progresses, ventilation/perfusion imbalance developes in the lungs and this leads to hypoxemia (2). Tissue hypoxia occurs when arterial partial oxygen pressure (PaO2) falls below 60 mmHg and this causes systemic effects.

In this study, we evaluated the effects of COPD on VEP. P1 value, which reflects the functional integrity of visual pathway, was significantly elevated in COPD patients than healthy control subjects. This difference was thought to be due to hypoxemia caused by COPD. In this study, there was only one female COPD patient, and there was a significant difference between the groups according to gender. That's why the data of male patients were reevaluated and compared with the male control subjects. P1 value was still significantly higher in male COPD patients than male control subject. Thus, as the visual pathways of COPD patients were affected due to chronic hypoxemia, visual quality of these patients were found to be lower than control subjects.

To evaluate the effects of smoking on

VEP values, we compared the VEP results of smoker COPD patients with ex-smoker COPD patients. There were no differences for any of the parameters measured between the groups. As a conclusion, VEPs, particularly P1 value, alters in COPD patients. This change in VEPs was thought to be due to hypoxemia caused by ventilation-perfusion imbalance in COPD.

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