Fast Transient Visual Evoked Potential Correlates with Functional and Structural Damage in Glaucoma

V Trubnik[1], TS Prata[1], VC Lima[1], CGV De Moraes[1], JM Liebmann[1,2], R Ritch[1,3], C Tello[1,3]

[1]Einhorn Clinical Research Center, New York Eye and Ear Infirmary, NY, NY, [2]New York University School of Medicine, NY, NY
[3]New York Medical College, Valhalla, NY.

Introduction

- Despite recent technological advances, glaucoma diagnosis and management is still based primarily on clinical assessment of the visual field and the optic nerve.
- However, in order to evaluate early damage and its progression over time, different technologies for objective and quantitative measurement of structural and functional changes have emerged.
- The conventional pattern reversal visual evoked potential technique is an objective method of evaluating the integrity of the visual pathway.

Purpose

- We investigated the correlation between structural and functional damage in patients with asymmetric glaucoma using a fast transient visual evoked potential (ftVEP) technique.

Methods

- Twenty five patients with visual acuity ≥ 20/30 and asymmetric visual field loss [VF; difference in mean deviation (MD) index of at least 3db] were enrolled. Subjects with neurological disease or ocular diseases other than glaucoma were excluded.
- Patients underwent optical coherence tomography (Stratus OCT) for macular thickness measurement, scanning laser polarimetry with variable corneal compensator (GDx-VCC) for retinal nerve fiber layer measurement and ftVEP (10% and 85% Michelson of contrast, acquisition time of 20 seconds) in both eyes within 2 months.
- The correlation between VF MD index and ftVEP delta P100-N75 amplitude and P100 latency was assessed using linear regression analysis.
- In addition, the correlation between each ftVEP parameter and structural test results [OCT (macular thickness) and GDx-VCC (peripapillary RNFL thickness)] was evaluated separately in eyes with better and worse MD.

Results

- There was a significant difference in VF MD values between the more and less affected eyes (-13.7± 6.7 vs. -3.8±1.9 db, p<0.001).
- Using ftVEP 10% contrast, VF MD values correlated significantly with both amplitude (r=0.33, p=0.01) and latency (r=-0.61, p<0.01).
- When using 85% contrast, VF MD values correlated significantly with amplitude results (r=0.32, p=0.01) , but not with latency (p=0.46)
- In eyes with more advanced VF loss, there was a positive and significant correlation between ftVEP amplitude (85% contrast) and macular thickness on OCT (r=0.47, p=0.01), but not with GDx-VCC TSNIT average (p=0.26).
- No other significant structure and functional correlation was observed when using 10% contrast or during assessment of less affected eyes.

Table 1. Demographic and Clinical Characteristics

Variable	Patients (n=25)
Age (years)	61.5 ± 16.1
Gender (male/female)	6/19
Race (C/AD/H/A)	15/3/4/3
Mean baseline BCVA (logMAR)	0.11 ± 0.1
Glaucoma diagnoses	
Primary open-angle glaucoma	40% (10/25)
Chronic angle-closure glaucoma	28% (7/25)
Others	32% (8/25)

C, Caucasian; AD, African descent; H, Hispanic; A, Asian; BCVA, best corrected visual acuity.
Data are given as mean ± standard deviation whenever indicated.

Table 2. Functional and Structural Tests

Parameters	Eyes with better MD	Fellow Eyes with worse MD	*P* value*
ftVEP 10% contrast latency (ms)	111.6 ± 13.1	150.5 ± 38.1	<0.001
ft VEP 10% contrast amplitude (mV)	4.2 ± 2.4	2.3 ± 1.1	<0.001
ftVEP 85% contrast latency (ms)	109.4 ± 10.2	110.5 ± 13.3	0.75
ft VEP 85% contrast amplitude (mV)	8.3 ± 5.4	6.4 ± 3.6	0.01
Average RNFL thickness (GDx-VCC, µm)	46.4 ± 8.4	38.3 ± 8.5	<0.01
Macular thickness (Stratus OCT, µm)	258.2 ± 20.9	240.3 ± 30.1	<0.01

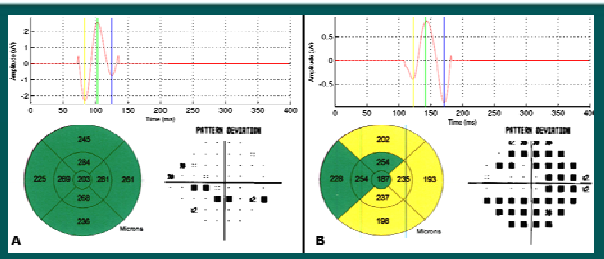

Figure 1: Test results of a patient with asymmetric glaucoma. The right eye (A) has less damage than the left eye (B) based on optical coherence tomography and visual field results (MD, -3.90 dB vs -19.69 dB). Fast transient visual evoked potential results (10% contrast) show latency delay and amplitude reduction in the left eye when compared to the right eye.

Discussion

- There was a significant correlation between SAP and ftVEP results in glaucomatous eyes. Eyes with worse MD had a more delayed latency and reduced amplitude.
- Despite the fact that amplitude correlated with MD values at both 10% and 85%, latency correlated significantly with MD at 10% contrast, but not at 85%. This may suggest that the technique is better performed at lower contrast stimuli.
- The correlation between ftVEP results and structural measurements was weak, which could be explained by the fact that additional post-retinal factors could be contributing to the observed reduced amplitude and delayed latency found in these patients.

Conclusion

Using a ftVEP technique, a good correlation between VEP results, specifically amplitude, and the level of VF damage in patients with asymmetric glaucoma was found. In addition, eyes with decreased VEP amplitude also had reduced macular thickness. These structural and functional correlations suggest that ftVEP warrants further investigation as a fast and objective method to assess functional damage in glaucomatous eyes.

References

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