Correlations between optical coherence tomography, pattern ERG and visual evoked potentials in patients with ocular hypertension and open angle glaucoma

G. L. Marmi1, V. Parisi1,2, S. A. Gandolfi3, M. Centofanti2, G. Colaizzo1, S. Marchi1, M. G. Buccig. 1

1Eye Clinic, University of Rome “Tor Vergata”, Rome, Italy, and G.B. Bettì Foundation for Ophthalmology, Rome; 2AFA-CRCCS, Eye Division, Fatebenefratelli Hospital, Isola Tiberina, Rome; 3Istituto of Ophthalmology, University of Parma, Italy.

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Introduction
Psychophysical (Pomerance & Evans 1994) and electrophysiological (Pfeiffer et al. 1992, Parisi 1997) experiments have described an impaired visual function in patients with elevated intraocular pressure (IOP) with or without visual field defects used by white-on-white computer-assisted static perimetry.

Optical Coherence Tomography (OCT), a recently developed technique, provides an “in vivo” scanning of the retinal layers. The device is based on the interferometry principle and a superluminescent diode is used as a source. The resolution limit is approximately 10 microns (Huang et al. 1991). Retinal thickness measurements are obtained automatically by means of a computer algorithm that searches for the characteristic changes in reflectivity observed at the superficial and deep retinal boundaries (Huang et al. 1991). Experiments performed on glaucomatous eyes have shown topographically correlated correlation between visual field defects and localized or diffused thinning of the nerve fiber layers (Swanson & Fujimoto 1995).

We used OCT on eyes with ocular hypertension (OHT) and open angle glaucoma (POAG), correlating nerve fiber layer (NFL) thickness data with electrophysiological parameters obtained by Pattern Electroretinogram (PERG) and Visual Evoked Potential (VEP) recordings. Our aim was to discover if any correlation exists between NFL thickness and retinal (PERG) and cortical (VEP) responses in patients with ocular hypertension or open angle glaucoma (POAG).

Patients and Methods
Thirty-two patients (mean age 48.3±9.1 years; refractive error between +2 and -2 sph) with mean deviation of computerized static perimetry (24/2 Humphrey) < -1.5 dB, IOP between 23 and 28 mmHg (OHT group) and 20 patients (mean age 53.2±13.3 years, refractive error between +2 and -2 sph) with mean deviation of computerized static perimetry (24/2 Humphrey) between -4 and -8 dB, IOP < 21 mmHg with medical treatment (POAG group) were enrolled.

NFL thickness was measured by OCT (1.7 mm radius circular scanning). In the assessed eyes, we considered the average of the values obtained in three different measurements in each quadrant: superior (NFLS), inferior (NFLI), nasal (NFLN), and temporal (NFLT); the mean of the 12 measurements was termed the NFL Overall (NFLO).

Table 1. Linear regression and correlation between NFL thickness and electrophysiological parameters in OHT and POAG patients.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OHT</th>
<th>POAG</th>
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<tbody>
<tr>
<td>PERG P50 latency</td>
<td>r = -0.72, p &lt; 0.001</td>
<td>r = -0.65, p &lt; 0.01</td>
</tr>
<tr>
<td>PERG N95 amplitude</td>
<td>r = -0.73, p &lt; 0.001</td>
<td>r = -0.66, p &lt; 0.01</td>
</tr>
<tr>
<td>VEP P100 latency</td>
<td>r = -0.75, p &lt; 0.001</td>
<td>r = -0.65, p &lt; 0.01</td>
</tr>
<tr>
<td>VEP N75-P100 amplitudes</td>
<td>r = -0.72, p &lt; 0.001</td>
<td>r = -0.65, p &lt; 0.01</td>
</tr>
</tbody>
</table>

PERGs and VEPs were recorded using checkerboard pattern, each square subtending 15° of visual arc with a contrast of 70%, and a reversal rate of 2 per sec (Biomedica Mangoni, Pisa, Italy) (Parisi 1997).

Linear regression analyses were employed to establish the correlations between NFL and PERG and VEP parameters.

Results
Table 1 shows that in OHT and POAG patients there was an inverse correlation between PERG P50 latency andNFL thickness: PERG P50-N95 amplitude correlated directly with NFL thickness.

In OHT patients VEP P100 latencies or VEP N75-P100 amplitudes were significantly correlated with NFL thickness, while in POAG patients no correlations between VEP P100 latencies or VEP N75-P100 amplitudes and NFL thickness were found.

Conclusions
In OHT patients, the retinal and cortical responses are dominated by retinal morphology. In POAG patients the retinal responses are dominated by retinal morphology, while the cortical responses seem to be independent of the measured nerve fibre thickness.

In humans, the nerve fibre thickness measured by OCT can be correlated with electrophysiological responses (PERG) assumed to be originating in the innermost retinal layers (Maffei & Fiorinetti 1981).

References


