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

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Introduction

Psychophysical (Pomerance & Evans 1994) and electrophysiological (Pfeiffer et al. 1993; Parisi 1997) experiments have described an impaired visual function in patients with elevated intra-ocular pressure (IOP) with or without visual field defects tested 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 extensively shown topographical correlation between visual field defects and localized or diffused thinning of the nerve fibre layers (Swanson & Fujimoto 1995).

We used OCT on eyes with ocular hypertension (OHT) and open angle glaucoma (POAG), correlating nerve fibre 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.

vs	PERG P50 latency	PERG P50-N95 ampl	VEP P100 Latency	VEPN75−P100 ampl
OHT (n=32)				
NFLO	r: −0.470, p=0.007	r: 0.518, p=0.002	r: −0.422, p=0.01	r: 0.460, p=0.008
NFLT	r: −0.404, p=0.02	r: 0.493, p=0.004	r: −0.447, p=0.01	r: 0.349, p=0.043
POAG (n=20)				
NFLO	r: −0.775, p<0.001	r: 0.709, p<0.001	r: −0.503, p=0.023	r: 0.275, p=0.238
NFLT	r: −0.772, p<0.001	r: 0.658, p=0.001	r: −0.509, p=0.021	r: 0.240, p=0.307

PERGs and VEPs were recorded using checkerboard patterns, 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 and NFL 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 human eyes, the nerve fibre thickness measured by OCT can be correlated with electrophysiological responses (PERG) assumed to be originating in the innermost retinal layers (Maffei & Fiorentini 1981).

References

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