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Testing retinal sensivitiy in ocular hypertension using automated colour perimetry

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SUMMARY

The aim of this study was to compare the sensitivity of the white and the blue stimuli using macular full threshold and peripheral 60-4 testing strategies of the Humphrey field analyzer in patients with ocular hypertension. Ninety-eight eyes of 49 patients with ocular hypertension were examined using white and blue stimuli. A decrease in retinal sensitivity in six eyes (6.12%) was more prominent in the macular full threshold and peripheral 60-4 threshold tests when the blue stimulus was used. The results show that these tests are important in detecting the early retinal damage.

Key Words: *Ocular hypertension, retinal sensitivity, white and blue sensitivity, automated perimetry.*

Experimental and clinical studies have shown that the nerve fibres through which the blue light is transferred, are more sensitive to the increase of intraocular pressure. Making a use of this characteristic of these nerve fibres, it was pointed out that the threshold perimeter tests can take an important role in determining early glaucomatous damage (1-6).

MATERIAL AND METHOD

A cohort of 116 cases were examined and ninety-eight eyes of 49 cases (29 females and 20 males aged between 21-36 years) whose uncorrected Snellen visual acuities 0.6 or better were included in the study. All cases had intraocular pressures between 21-28 mmHg and c/d ratios 0.4 or less. Refraction examinations were done using an autorefractometer. After conducting slit lamp examination, cases with corneal lesions and ptosis hindering the sight were excluded from the study. IOPs were measured using applanation tonometry.

Humphrey Field Analyzer (HFA) 740 was used in the study. Macular full threshold and peripheral 60-4 threshold tests were applied using white and blue stimuli. Fixation losses below 20% and false negative or false positive results less than 33% were evaluated.

Result of the tests were printed on a paper in a way that would show the numerical values as grey scale and in dB. Having excluded the effects of a probable common depression in the pattern deviation maps which were revealed by the macular full threshold test, the defect depths which were at least 4 dB below the expected threshold values for the age of the patient were noted (7). The peripheral visual field was done using the method described by Jaffe et al (8). Results of the peripheral 60-4 threshold test were evaluated as a whole, since they were not values found in the normal population which were stored in the memory of the computer and did not give the global index values informing about the general sensitivity. The macular full threshold degrees on the pattern visual field was divided into central area, blind point area, upper and lower nasal central step, upper and lower Bjerrum, upper and lower peripheral and temporal peripheral areas. The peripheral visual field was evaluated after dividing it into upper and lower quadrants in the temporal and nasal fields.

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Table 1. *The average values obtained by the white and blue stimuli in Macular full threshold scanning.*

	White	Blue
	Aver ± 8 D(dB)	**Aver ± 8 D(dB)**
Normal group	26.35±2.02	17.16±0.95
Ocular HT	26.02±1.14	15.61±1.51

The following characteristics were taken as field damage criterion for the ocular hypertension:

1. Enlargement of the blind spot: 2-5 abreast defects adjacent to the blind spot.
2. Paracentral depression: 2-5 defects non abreast in the Bjerrum area.
3. Central peripheral depression: at least 3 abreast defects outside the Bjerrum area.
4. Common depression: Depression of all points in the same level.
5. Temporal step: at least a 5 degree loss in the temporal of the vertical line.
6. Peripheral depression: at least 3 or adjacent 3 defects 30 degrees.

Data were analysed by using unpaired Student's t test.

RESULTS

Macular full threshold scanning values of the normal and ocular hypertension groups are given in Table 1. The mean values in the normal group were 26.35±2.02 dB with the white and 17.16±0.95 dB with the blue stimuli. The mean values of the ocular hypertension group were 26.02±1.14 dB with the white and 15.61±1.51dB with the blue stimuli. The difference between the normal and the ocular hypertension group was statistically significant when the blue stimulus was used (P=0.0005) but not significant when white stimulus was used (P=0.317).

When the decrease of sensitivity was evaluated, accepting the average values of normal cases obtained with the blue and white stimulus as 100%, the decrease of the sensitivity when the blue stimulus used was found more. When we consider the values of the normal cases as 100%, the decrease of the sensitivity when the blue stimulus used was always more than the values obtained with the white stimulus in cases with ocular hypertension, Table 2. It shows us that the defect of the blue axis appears earlier than the white in cases of raised intraocular pressure.

DISCUSSION

The aim of our study was to compare the sensitivity of the retina to the white and blue stimuli in cases with ocular hypertension, using macular full threshold and peripheral 60-4 threshold tests with the computerized Humphrey perimeter. Quigley et al. and Drance et al. showed that the short wave light sensitivity deteriorates in eyes with glaucomatous defects (2,9). Therefore, we basically used the blue stimulus in our study and did the tests with the white stimulus so that we could compare the results. In the majority of the cases with probable glaucoma; yellow, blue or tritan defects appeared (10).

In the study, the value obtained with the blue stimulus in macular full threshold tests in all cases was significantly lower than the value obtained with the white stimulus. This may show that a blue stimulus has less stimulating effect than the white stimulus (11).

In comparison of normal cases and ocular hypertensive patients when white stimulus used in the macular full threshold testing, the decrease in sensitivity

Table 2. *The percentage of relative decrease in retinal sensitivity in the ocular hypertension group compared to normal cases.*

	Normal	Ocular Hypertension	
		Macular Full Threshold	**Peripheral 60-4**
White	100%	1.25%	3.50%
Blue	100%	9.03%	24.0%

in ocular hypertensives was significant. When the blue stimulus was used, the average sensitivity in the normal cases and the ocular hypertension group were 17.16±0.95 dB and 15.61±1.51 dB respectively, and the difference was highly significant (P=0.0005).

When the macular full threshold scanning values were evaluated either according to the quadrants or separately compared in four quadrants in normal and ocular hypertension groups, the decrease in the nasal quadrant was more prominent than the temporal quadrant. This was also showed by Devranoğlu et al. in previous studies (12).

In a study, Gündüz et al. have shown that tritan colour contrast sensitivity in ocular hypertension was impaired similar to glaucoma in a considerable number of cases (13) and the cause of the disorder in the blue-yellow axis in cases of glaucoma is due to the fact that the cone sensitivity to blue and its neural connections are more sensitive to the increase of the IOP than the red-green cones (9,10,13,14). Hart and Gordon studied the color vision function of the retina in cases with glaucoma and glaucoma suspects and stated that undetected new defects appear when the white stimulus is used with the blue (7).

The studies carried out for a long time have shown that 1% of the patients with ocular hypertension may develop glaucomatous damage each year and the incidence may be 10% in five years and 10% ten years later (15).

Caprioli and Spaeth, using automatic static perimetry techniques, found peripheral visual field defects in 11% of the patients who have normal central fields (16). In our study, we detected 3.50 % defect with the white and 24.0% defect with the blue stimulus in peripheral 60-4 test in patients with ocular hypertension, Table 2, whereas Danheim showed a frequency of 26% of peripheral nasal field defects in patients with early glaucoma (17).

As a result, macular full threshold scanning tests carried out with the blue stimulus can give quite useful clues in determining the retinal damage induced with ocular hypertension. Although addition of an extra time to the peripheral tests is a disadvantage, we believe that the peripheral 60-4 visual field testing will help us to diagnose early retinal damage.

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