SIMPLE CRITERIA FOR DETECTING GLAUCOMATOUS PERIMETRIC DEFECTS IN HIGH MYOPIA

GUIDO CORALLO, PAOLO CAPRIS, ENRICO GANDOLFO, ANGELO MACRI, CRISTINA GUIDI and MARIO ZINGIRIAN

Department of Neurological Sciences and Vision (Ophthalmology R), University of Genoa, Genoa, Italy

Abstract

The authors have tried to define some useful, simple criteria for better differentiating between myopic and glaucomatous perimetric defects when high myopia and glaucoma co-exist. Sixty-four perimetric maps (Humphrey 640 VFA, Threshold Central 30-2 Program) from 36 patients affected by both glaucoma and high myopia and 42 perimetric maps from 25 high myopia subjects without glaucoma were evaluated by two trained perimetrists who were unaware of the characteristics of the patients (double-masked study). All subjects were classified as glaucomatous or not based on the following elements: 1. mean deviation (MD), pattern standard deviation (PSD) and short-term fluctuation (SF) values; 2. the results of the glaucoma hemifield test (GHT); 3. the presence of pericentral alterations; 4. the presence of localized defects; 5. the presence of a nasal step; and 6. the presence of peripheral absolute defects, suspected of being artifacts by trial lens. Points 3, 4, 5 and 6 were evaluated according to simple, predetermined criteria. The two perimetrists showed very good agreement when classifying the patients as glaucomatous or not. The criteria we adopted showed good sensitivity but, unfortunately, poor specificity.

Introduction

The reading of perimetric findings when glaucoma and high myopia co-exist is often questionable due to the difficulty of separating glaucomatous defects from those caused by myopia itself. Moreover, the earliest manifestations of glaucoma in a visual field (VF) may reveal themselves by means of different patterns, such as a general reduction of sensitivity (also present in most high-myopia eyes), the presence of localized defects in the central field, or the combination of these findings, thus increasing interpretative doubts. Perimetric indices, generally very useful for correct perimetric map reading, are often greatly influenced when elevated myopia is present by the enlargement of the blind spot caused by peripapillary crescents and by peripheral absolute defects, not rarely caused by the high power of the trial lenses needed. The data obtained from other diagnostic techniques, such as computerized optic disc analy-
sis, are often uncertain due to myopic optic nerve head alterations. We made an attempt to identify simple criteria in order to reduce the difficulties of differentiating between myopic and early glaucomatous perimetric defects in high myopia.

Material and methods

We reviewed the perimetric findings (Humphrey 640 VFA, Threshold Central 30-2 Program) of 92 elevated myopia patients affected by glaucoma who came under our observation at the University of Genoa Eye Clinic’s Glaucoma Service and underwent various VF examinations at the Perimetry Service of the institute. Patients satisfying the inclusion criteria below were admitted to the study:
1. myopia $\geq$ 7 D
2. astigmatism <2 D
3. visual acuity >0.5
4. transparency of dioptric media
5. absence of concomitant general or ocular diseases
6. myopic maculopathy < grade 2, according to Avila’s classification \(^5\)
7. good perimetric reliability indices
8. intraocular pressure $\geq$ 25 mmHg (two or more readings)
9. non-pupillokinetic antiglaucomatous therapy

On the basis of these criteria, 36 patients (64 eyes) were included in the study. Ages ranged from 24 to 63 years (mean 41 ± 8) and degrees of myopia from -7 D to -18 D (mean -10 ± 3). Also selected was a group of 25 high myopia subjects without glaucoma (42 eyes), aged between 30 and 58 years (mean 40 ± 6) and myopia between -7 D and -16 D (mean -11 ± 2), each meeting the first seven criteria listed above, with tonometric values measured several times as being $\leq$ 16 mmHg. These subjects also had at least two perimetric examinations with the same program as the other group. The first examination was discarded so as to minimize the learning effect. Suitable optical correction was always used for full neutralization of the accommodation (additional +3 D to the myopia correction) in order to reduce the optical aberration phenomena of the corrective lens to a minimum. The findings relating to both groups were examined separately in random order by two trained perimetrists who did not participate in the patient selection and did not know to which group each perimetric map belonged. They classified the subjects as glaucomatous or not on the basis of the factors listed below:
1. annotation of MD, PSD and SF values
2. annotation of GHT results
3. evaluation of pericecal area
4. evaluation of the presence of localized defects
5. evaluation of the nasal step
6. evaluation of peripheral absolute defects, suspected of being artifacts by trial lens

With the exception of points 1 and 2, which obviously did not need any further elaboration, the other points were evaluated on the basis of the following criteria:
- Detection of pericecal area alterations (PAA): pattern deviation map count of the number of points on the grid surrounding the blind spot (i.e., the ten points located on the line immediately adjacent to the cecal area), corresponding to $p<0.5$ probability symbols; the presence of two or more points showing these characteristics was assumed significant.
- Detection of localized defects (LD): we adopted the criteria suggested by Caprioli et
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According to Al., a glaucomatous LD is considered to be present when at least the following findings occur: 1. two or more adjacent points with a 10dB or greater loss in the superior arcuate or inferior arcuate zones, compared with perimeter-defined age-matched normal values; 2. three or more adjacent points with a 5dB or greater loss at the superior or inferior arcuate areas; 3. a 10dB difference across the nasal horizontal midline in two or more adjacent locations.

- **Detection of the nasal step (NS):** consideration was taken of the number of opposing points across the nasal horizontal hemi-meridian that showed a difference of at least one interval of significance, as indicated by the probability symbols of the pattern deviation map. Three or more points showing these characteristics were assumed to be significant.

- **Detection of peripheral absolute defects (PAD),** thought to be artifacts by trial lenses: count of null sensitivity points located on the most external line of the grid and not confluent into other adjacent absolute defects. Two or more points showing these characteristics were assumed to be significant.

**Statistical analysis**

We used Spearman’s test for the correlation between the extent of the myopia and various other parameters, and the Mann-Whitney U test for comparison of the two groups of patients. For sensitivity and specificity calculations, we considered those subjects with pathological GHT (of whatever degree), who presented with one or more LD and three or more pairs of asymmetric points straddling the nasal horizontal hemi-meridian, to be truly positive.

**Results**

The two groups of subjects were comparable as to age and extent of myopia. The two perimetrists agreed in their VF assessment with no significant differences. A significant correlation was found for the MD ($p<0.0001$) and the PAA ($p<0.0001$) with refractive error extent, while the other perimetric indices, the NS and the PAD were not significantly correlated with it (Table 1). Comparison of the two groups showed significant differences for all the considered parameters with the exception of PAA and PAD (Table 2). In our sample, the criteria we used for individualization of LD and NS, such as GHT, proved to have good sensitivity but not very good specificity:

- LD: sensitivity 88%, specificity 68.8%
- NS: sensitivity 100%, specificity 65.4%
- GHT: sensitivity 86%, specificity 64.6%

**Discussion**

The comparison criteria for the two groups considered in this study allowed certain characteristics of glaucoma’s typical defects to be individualized, even when myopia-linked perimetric alterations were present. In particular, not specific to glaucomatous disease, being present also in myopia-only subjects, are blind spot modifications (correlated with refractive defect magnitude), peripheral absolute defects, and modifications of the perimetric indices (MD, PSD and SF). These last, even though statistically different in the two groups,
proved of little use clinically because of their extreme openness to influence by absolute defects, such as PAD and PAA. Significantly discriminatory, as might have been expected, were LD, asymmetry of superior and inferior hemifield (GHT), and NS. The criteria adopted for the detection of LD and of NS proved to be satisfactorily accurate (significant agreement between the two perimetrists), easy, and of practical clinical utilization. They do not need any complex calculations and may be utilized even by ophthalmologists who have no particular experience in perimetry. We do not, of course, have the pretension of having completely solved the old problem of the detection of glaucomatous perimetric defects in high myopia, as the title of this paper might suggest. Unfortunately, the specificity of our criteria was poor; moreover, a major difficulty is represented by those cases of initial glaucoma whose earliest perimetric manifestation is a generalized depression of sensitivity. Nevertheless, we hope to have found the way to remove at least some of the obstacles.

References


Table 1. Correlation between myopia degree and MD (mean deviation), PSD (pattern standard deviation), SF (short-term fluctuation), PAA (pericecal area alterations), PAD (peripheral absolute defects) and NS (nasal step)

<table>
<thead>
<tr>
<th>Myopia degree</th>
<th>Spearman correlation coefficients (r)</th>
<th>Significance (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD</td>
<td>0.48</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>PSD</td>
<td>0.24</td>
<td>not significant</td>
</tr>
<tr>
<td>SF</td>
<td>0.08</td>
<td>not significant</td>
</tr>
<tr>
<td>PAA</td>
<td>0.48</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>PAD</td>
<td>-0.07</td>
<td>not significant</td>
</tr>
<tr>
<td>NS</td>
<td>-0.06</td>
<td>not significant</td>
</tr>
</tbody>
</table>

Table 2. Average ± standard deviation and statistical differences (Mann-Whitney U test) between the two groups

<table>
<thead>
<tr>
<th></th>
<th>Myopia</th>
<th>Myopia and glaucoma</th>
<th>Significance (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD</td>
<td>-4.2±1.6</td>
<td>-5.5±2.1</td>
<td>&lt;0.0006</td>
</tr>
<tr>
<td>PSD</td>
<td>3.02±1.3</td>
<td>4.6±2.5</td>
<td>&lt;0.0002</td>
</tr>
<tr>
<td>SF</td>
<td>1.3±0.4</td>
<td>1.8±0.9</td>
<td>&lt;0.04</td>
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<tr>
<td>LD</td>
<td>0.097±0.3</td>
<td>0.59±0.49</td>
<td>&lt;0.0006</td>
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<tr>
<td>PAA</td>
<td>1.23±1.84</td>
<td>1.79±1.35</td>
<td>not significant</td>
</tr>
<tr>
<td>GHT</td>
<td>0.29±0.8</td>
<td>1.32±1.19</td>
<td>&lt;0.0008</td>
</tr>
<tr>
<td>NS</td>
<td>0.06±0.25</td>
<td>2.06±1.95</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>PAD</td>
<td>0.00</td>
<td>0.41±1.35</td>
<td>not significant</td>
</tr>
</tbody>
</table>

MD: mean deviation; PSD: pattern standard deviation; SF: short-term fluctuation; LD: localized defects; PAA: pericecal alterations; GHT: glaucoma hemifield test; NS: nasal step; PAD: peripheral absolute defects
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