FALSE-NEGATIVE RATES IN THE VISUAL FIELDS OF GLAUCOMATOUS PATIENTS

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Abstract

In a retrospective study, the authors estimated the trend of false-negative rates in the visual fields of patients with primary open-angle glaucoma (POAG) at different stages of perimetric defect. They evaluated 166 visual fields of 65 glaucomatous patients (36 males, 29 females), aged from 44 to 81 years, with the Octopus 2000 R perimeter (G1 Program) over a three-year period (1995-1997). The visual fields were arbitrarily subdivided into seven groups according to an increasing mean defect (MD) perimetric index. For each group, they determined the regression analysis and the correlation coefficient between MD and false-negative rates. In the first six groups, (MD ≤21dB), there was no statistically significant correlation between MD and false-negative rates, while in the seventh group (MD >21dB), there was a systematic progression of false-negatives (p=0.017), with a correlation coefficient (r) of 0.414. The reliability should be reconsidered in these last visual fields.

Introduction

The reliability of an automatic perimetric test is fundamental in the diagnostic procedures to evaluate a patient affected by ocular hypertension or glaucoma. Usually the reliability is assessed by three measures: fixation loss, false-negative and false-positive rates. These last two parameters form the reliability factor (RF) of a visual field¹. For a glaucomatous patient, the visual field is sufficiently reliable if the RF is less than ten.

In the past few years, various authors have studied the influence of patient reliability on visual field outcome: Katz et al. found a large number of false-negative responses in glaucomatous patients²; Jenni found a clear correlation between the decrease of mean sensitivity and increase of false-negative responses³; De Natale found a correlation between RF and mean defect (MD) in glaucomatous patients⁴; Lee et al. found an increase of 10% of false-negative responses for every 1.2dB decrease of the mean sensitivity⁵; Katz and Sommer⁶ and other authors⁷,⁸ hypothesized that the increase of false-negative responses in glaucomatous patients was due to an increase of visual fatigue and to the variability of response in the early stages of the disease.

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The purpose of this study was to evaluate the trend of false-negative rates in the visual fields of glaucomatosus patients at different stages of perimetric defect.

Material and methods

In a retrospective study, we considered 166 visual fields of 65 patients (36 males, 29 females) with POAG, aged between 44 and 81 years. The visual fields were recorded with Octopus 2000 R automated perimetry (G1 Program). The inclusion criteria were as follows:

- visual acuity of 7/10 or better
- refractive error ≥3 Diopters
- absence of minimal lenticular opacities
- absence of retinal diseases
- pupillary diameter ≥3 mm
- IOP <21 mmHg
- experience of automatic static perimetry
- presence of at least one false-negative response in each visual field
- presence of not more than one false-positive response in each visual field

The visual fields were arbitrarily grouped into seven classes according to an increasing MD; for each class, the MD and the rate of false-negative responses (expressed in decimal fraction) was considered. The regression analysis and its coefficient between MD and false-negative rates were calculated.

Results

The results are reported in Tables 1 and 2. In Table 1, the range of MD considered for each class, the number of the visual fields recorded, and the distribution (%) of the false negatives, are reported. There is a percentage progression of false-negative rates from the first to the seventh class.

In Table 2, the regression analysis and its correlation coefficient (r) between MD and false-negative rates are calculated for each class. In the first six classes, the distribution of false-negatives is casual (p not significant), while in the seventh class, there is a statistically significant progressive (or systematic) pattern (p=0.017), a regression coefficient (r) of 0.414, and a slope of 0.05.

To go into more detail, in the range between 21 and 26dB of MD (seventh class) false-negative rates were calculated.

Table 1. False-negative distribution (%)

<table>
<thead>
<tr>
<th>Visual fields (n)</th>
<th>False negatives (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st class (MD &lt;4dB)</td>
<td>23</td>
<td>5.11</td>
</tr>
<tr>
<td>2nd class (MD 4.1-6dB)</td>
<td>18</td>
<td>5.60</td>
</tr>
<tr>
<td>3rd class (MD 6.1-9dB)</td>
<td>25</td>
<td>6.55</td>
</tr>
<tr>
<td>4th class (MD 9.1-12dB)</td>
<td>21</td>
<td>7.91</td>
</tr>
<tr>
<td>5th class (MD 12.1-16dB)</td>
<td>23</td>
<td>15.81</td>
</tr>
<tr>
<td>6th class (MD 16.1-21dB)</td>
<td>23</td>
<td>17.51</td>
</tr>
<tr>
<td>7th class (MD &gt;21dB)</td>
<td>33</td>
<td>30.39</td>
</tr>
</tbody>
</table>
False-negative rates in the visual fields of glaucomatous patients

\[ \text{negative percentage (\%FN)} = a + b \times \text{MD} + \epsilon \text{ (casual error)}, \]
and considering \( \epsilon \) to be negligible, \( \text{FN} = -0.859 + 0.05 \times \text{MD} \)

For \( \text{MD} = 21 \text{ dB} \), \( \text{FN} \) (\%) = \(-0.859 + 0.05 \times 21 = 0.191 \), \textit{i.e.,} 19\%

Using this value as the starting point (for example, 0.19), medium value of \( \text{FN} \) (\%) in function of \( \text{MD} \) is \( 0.19 + (\text{MD} - 21) \times 0.05 \)

Therefore, in the range considered, \( \text{FN} \) progression is \( 26-21 = 5 \times 0.05 = 0.25 \), \textit{i.e.,} 25\%.

**Discussion**

For perimetric defects with \( \text{MD} \) lower than 21dB, there is a percentage progression of false negatives, but the casual distribution of the false negatives is probably due to patients’ inattention or fatigue.

For \( \text{MD} \) values higher than 21dB, there is a significant progression of the false negatives according to increasing values of \( \text{MD} \). This could be attributed to the greater difficulty of patients with important perimetric defects to correctly perform the visual field examination. Moreover, it would be useful to reconsider the reliability of these visual fields, also in consideration of the systematic progression found in the false negatives.

**References**


**Table 2. Regression analysis between MD and false-negative rates**

<table>
<thead>
<tr>
<th>Class</th>
<th>MD Range</th>
<th>( b )</th>
<th>( a )</th>
<th>( r )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st class (MD &lt;4dB)</td>
<td>0.002</td>
<td>0.045</td>
<td>0.139</td>
<td>0.526</td>
<td></td>
</tr>
<tr>
<td>2nd class (MD 4.1-6dB)</td>
<td>-0.022</td>
<td>0.170</td>
<td>-0.366</td>
<td>0.135</td>
<td></td>
</tr>
<tr>
<td>3rd class (MD 6.1-9dB)</td>
<td>0.003</td>
<td>0.043</td>
<td>0.082</td>
<td>0.697</td>
<td></td>
</tr>
<tr>
<td>4th class (MD 9.1-12dB)</td>
<td>0.008</td>
<td>-0.006</td>
<td>0.150</td>
<td>0.518</td>
<td></td>
</tr>
<tr>
<td>5th class (MD 12.1-16dB)</td>
<td>-0.030</td>
<td>0.576</td>
<td>-0.351</td>
<td>0.101</td>
<td></td>
</tr>
<tr>
<td>6th class (MD 16.1-21dB)</td>
<td>0.018</td>
<td>-0.0166</td>
<td>0.319</td>
<td>0.137</td>
<td></td>
</tr>
<tr>
<td>7th class (MD &gt;21dB)</td>
<td>0.050</td>
<td>-0.859</td>
<td>0.414</td>
<td>0.017</td>
<td></td>
</tr>
</tbody>
</table>