Influence of the Optic Disc Size on Cup Diameter in Patients with Glaucoma Simplex Chronicum

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Introduction: The relationship between the optic disc size, neuroretinal rim and cup diameter is the key in identifying glaucomatous changes in optic nerve head. Like some other biological characteristics, changes of the optic disc differ among healthy populations, thus hindering detection of pathological changes. Materials and methods: From the total number of 90 patients, we selected those that have optic disc diameter less than 1.30 mm, greater than 2.10 mm, as well as patients with a size of disc diameter ranging from 1.31mm to 2.09 mm. In all patients after amnesia and standard ophthalmologic examination (best corrected visual acuity-BCVA, Goldman aplanatic tonometry, pachymetry, gonioscopy), we also performed the OCT analysis of the optic nerve head. Results and discussion: Glaucomatous changes in small optic discs may remain unnoticed unless there is a high degree of suspicion. The assessment of the optic disc size is an important, but often overlooked component of the diagnostic evaluation in glaucoma. There was a statistically significant strong positive correlation between the size of the optic disc diameter and cup diameter, larger optic disc diameter means greater cup diameter. Due to the large variation in the cup size in healthy subjects, the assessment of the morphology of the neuroretinal rim or cup diameter can be more helpful in evaluation of glaucomatous optic disc damage than the value of C/D ratio itself. Conclusion: Evaluation of the optic disc size and C/D ratio is an essential part in diagnostic procedure and management of glaucoma. OCT analysis in patients with small optic disc diameter showed the least sensitivity in all three categories (normal, abnormal and uncertain OCT results). The OCT results in the small optic disc diameter are the least reliable in the diagnosis of glaucoma. More complexed long term study is needed to evaluate this complicated relations between optic disc diameter, C/D ratio, neuroretinal rim and other important clinical factors in emerging glaucoma disease. Key words: optic disc, cup/disc ratio, glaucoma simplex chronicum, OCT

1. INTRODUCTION

Glaucoma represents a group of eye diseases in which there is damage to the optic nerve and can, if left untreated, result in a complete loss of vision. Glaucomatous disease is one of the most common causes of blindness in developed countries. To understand and assess the presence of glaucomatous changed optic nerve, it is necessary to know the characteristics of healthy optic discs.

There is a significant difference in the size of the optic disc among healthy populations. The size can vary from 0.80 mm² to about 6.00 mm² in the normal population (2) Values have a Gaussian distribution with significance (± SD) of 2.69 ± 0.70mm² These figures relate to healthy Caucasian and may vary in relation to other populations. Much more important than the optic disc classification according to its size, is how the size of the disc affects cup diameter and neuroretinal rim area.

Determining the size of the cup and its relation to the size of the disc, ie C/D ratio, is widely used to distinguish glaucomatous and healthy eyes. Vertical cup expansion is typical characteristic of glaucomatous optic neuropathy. Size of cup in the normal population is largely dependent on the physiological relationship of the cup ratio and the size of the optic nerve head. (1,7)

With the increase of disc size grows as well and C/D ratio, so large optic disc in healthy people have large C/D ratio which may lead to wrong diagnosis of glaucoma. Similarly small cup in small optic disc can be glaucomatous. Involving the optic disc size in estimation of the E/D ratio proves the correctness of the measurements in the detection of glaucoma (7). Moreover, examination of other disc characteristics will help us in establishing diagnosis.

2. MATERIALS AND METHODS

In order to make scientifically valuable statistical comparisons we tested approximately 60 eyes in each group, a total of 180 eyes. From the total number of 90 patients, we selected those that have optic disc diameter less than 1.30 mm, greater than 2.10 mm, as well as patients with a size of disc diameter ranging from 1.31mm to 2.09 mm. In order to make scientifically valuable statistical comparisons we tested approxi-
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In approximately 60 eyes in each group, a total of 180 eyes. The control group consisted of patients with medium-sized optic disc values (1.31-2.09mm).

In all patients after anamnesis and standard ophthalmologic examination (best corrected visual acuity-BCVA, Goldman aplanatic tonometry, pachymetry, gonioscopy), we also performed the OCT analysis of the optic nerve head. All patients had either one of the following diagnosis Glaucoma in obs or Glaucoma chronicum simplex.

3. RESULTS

Analysing these parameters, we have come to the results as follows:

The average value of the optic disc diameter in group I amounted to 1.31 ± 0.07 mm in group II, 1.75 ± 0.19 mm, and in group III 2.31 ± 0.19 mm. There was a statistically significant difference in mean values of optic disc diameters between all the groups, F = 512.131; df = 2; p = 0.001.

In Table 2 we analyzed the average value of the cup diameters by groups. The average value of the cup diameter in group I amounted 0.68 ± 0.26 mm in group II, 1.05 ± 0.34 mm, while in group III it was 1.38 ± 0.37 mm.

There was a statistically significant difference in mean values between the cup diameters across the groups, F = 64.906; df = 2; p = 0.001.

In Table 3 we analyzed the average value of the cup/disc ratio (C/D) in each group. The average value of C/D in group I is 0.56 ± 0.16, in group II, 0.69 ± 0.15, while in group III, the average value of C/D is 0.73 ± 0.13.

ANOVA test showed that there is a statistically significant difference in mean values C/D between all analyzed groups, F = 19.32; df = 2, p = 0.001.

There was a statistically significant strong positive correlation between the size of the optic disc diameter and cup diameter, larger optic disc diameter means greater cup diameter, r = 0.706, p = 0.001.

4. DISCUSSION

Small optic disc is usually difficult to determine. Assessment of optic disc size is an important, but often overlooked component of the diagnostic evaluation in glaucoma. Glaucomatous changes in small discs may remain unnoticed unless there is a high degree of suspicion. The reason for this is that the C/D ratio remains low until significant changes in expression of the disease become revealed. Due to the large variation in the cup size in healthy subjects, the assessment of the morphology of the neuroretinal rim or cup diameter can be more helpful in evaluation of glaucomatous optic disc damage than the value of C/D ratio itself.

According Iester-in, Mickelberg and Drance (1) estimation the size of the optic disc drive is an important factor in the diagnosis of glaucoma. That is why it would be very helpful if there were a single method for estimating the size of the optic disc.

<table>
<thead>
<tr>
<th>X</th>
<th>SD</th>
<th>SEM</th>
<th>95% CI</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
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<tr>
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<td>Group II</td>
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<td>0.19</td>
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<td>1.70</td>
<td>1.80</td>
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<tr>
<td>Group III</td>
<td>2.31</td>
<td>0.19</td>
<td>0.02</td>
<td>2.26</td>
<td>2.36</td>
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</table>

F=512.131; df=2; p=0.001

Table 1. The average value of the diameter of the papilla (OCT)

<table>
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<tr>
<th>X</th>
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<th>SEM</th>
<th>95% CI</th>
<th>Minimum</th>
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<td>0.37</td>
<td>0.04</td>
<td>1.28</td>
<td>1.47</td>
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</table>

F=64.906; df=2; p=0.001

Table 2. The average value of the cup size (OCT)

<table>
<thead>
<tr>
<th>X</th>
<th>SD</th>
<th>SEM</th>
<th>95% CI</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.02</td>
<td>0.52</td>
<td>0.61</td>
</tr>
<tr>
<td>Group II</td>
<td>0.69</td>
<td>0.15</td>
<td>0.01</td>
<td>0.65</td>
<td>0.73</td>
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<tr>
<td>Group III</td>
<td>0.73</td>
<td>0.13</td>
<td>0.01</td>
<td>0.69</td>
<td>0.76</td>
</tr>
</tbody>
</table>

F=19.32; df=2; p=0.001

Table 3. The average values of the cup/disc ratio (C/D)
Influence of the Optic Disc Size on Cup Diameter in Patients with Glaucoma Simplex Chronicum

Jonas et al (3) have made a few studious examinations regarding morphometric optical disc characteristics and the importance of taking it into consideration in the diagnosis of glaucoma (3, 4, 5) According to Jonas, C/D ratio can range from 0.0 to 0.9 in the healthy population (1) and there is significant overlap between the normal and glaucomatous eyes. (2, 3) Blue Mountains Eye Study (6) (6.678 eyes) showed a positive correlation between C/D ratio and the size of the optic disc.

In their study, C/D ratio increased from 0.35 to 0.55 from small (1.1 to 1.31 mm) to large (1.8 to 2.0 mm) disc diameter by linear progression in the horizontal and 95% of the vertical disc diameter.

Although the C/D ratio can be easily determined by ophthalmologists and do not require additional imaging equipment, the single measurement has limited value in assessing glaucomatous damage if not adjusted for the disc size of the (7, 8). This means that the relationship between the optic disc size and C/D ratio is very important considering that large cup diameters may be physiological in a large disc, while an average C/D ratio at a small disc is actually an early sign of glaucoma. Therefore, there is a tendency to set a false positive diagnosis in a large disc, as well as it is possible to overlook the diagnosis of existing glaucoma in a small disc.

5. CONCLUSIONS

The relationship between the size of the papilla, neuroretinal rim and cup diameter, are crucial in identifying glaucomatous changes of the optic nerve head (8,9). Therefore, the evaluation of the optic disc size and C/D ratio is an essential part in diagnostic procedure and management of glaucoma.

The analysis of the average cup value in a relation to the findings of the OCT image, found that there is a statistically significant difference between the groups (10). OCT analysis in patients with small optic disc diameter showed the least sensitivity in all three categories (normal, abnormal and uncertain OCT results). The OCT results in the small optic disc diameter are the least reliable in the diagnosis of glaucoma.

It has been shown that the cup diameter was 0.64 mm in group I, then 1.11 mm in group II, and 1.40 mm in group III, at the level of the statistical significance, indicate glaucoma presence which was confirmed by Visal Field analysis and OCT analysis of the optic disc.

More complexed long term study is needed to evaluate this complicated relations between optic disc diameter, C/D ratio, neuroretinal rim and other important clinical factors in emerging glaucoma disease.

REFERENCES

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