ABSTRACT

Purpose: To analyze changes in peripapillary retinal nerve fiber layer (RNFL) after cataract surgery.

Methods: The average RNFL thickness of patients who underwent cataract surgery was measured using the optical coherence tomography (OCT) III Stratus® before surgery, the day after and one month later. The data were analyzed using the SPSS 12.0 software. We used paired two tail student’s t test for comparisons.

Results: The study group was composed by 74 eyes of 74 patients. The RNFL thickness average was 90.71 µm (SD: 19.93), 88.30 µm (SD: 20.59) and 97.45 µm (SD: 14.30), before cataract surgery (AVGT0), the day after surgery (AVGT1) and one month later (AVGT2) respectively. We did not find statistically significant difference between AVGT0 and AVGT1 (P=0.37); however, statistically significant difference between AVGT1 and AVGT2 (P=0.002) as well as in the image signal quality between AVGT0 and AVGT2 (P=0.0001).

Conclusions: The RNFL average thickness measured by OCT III Stratus® showed an increase one month after surgery.

RESUMEN

Objetivos: Analizar cambios en el espesor de la capa de fibras nerviosas de la retina (CFNR) peripapilar tras cirugía de cataratas.

Métodos: Medición del espesor medio de la CFNR de pacientes sometidos a cirugía de cataratas utilizando tomografía de coherencia óptica (OCT) III Stratus® antes de la cirugía, un día después de la intervención y transcurrido un mes. Los datos fueron analizados mediante el programa informático SPSS 12.0. Los resultados fueron comparados empleando el test pareado de dos colas t de Student.

Resultados: El grupo de estudio estaba compuesto de 74 ojos de 74 pacientes. El espesor medio de la CFNR antes de la cirugía de cataratas (AVGT0) fue 90.71 µm (DE: 19.93), el día después de la cirugía (AVGT1) fue 88.30 µm (DE: 20.59); y un mes después (AVGT2) 97.45 µm (DE: 14.30). No se encontraron diferencias estadísticamente significativas entre AVGT0 y AVGT1 (P=0.37); sin embargo, dicha diferencia sí se encontró entre AVGT1 y AVGT2 (P=0.002). También se encontró diferencia...
month after cataract surgery. This phenomenon is accompanied with an improvement in signal quality (Arch Soc Esp Oftalmol 2009; 84: 305-310).

Key words: Optical Coherence Tomography, cataract surgery, optic nerve; follow-up studies, glaucoma.

INTRODUCTION

A present, cataract surgery with phacoemulsification continues to be one of the most popular surgical procedures in ophthalmologic practice. Due to the introduction of new retinal imaging techniques such as Optical Coherence Tomography (OCT), it is possible to perform accurate, high-resolution studies of changes taking place at the level of average thickness of the peripapillary retinal nerve fiber layer (RNFL) after eye surgery, even when those changes are subtle (1).

The presence of cataracts and other alterations modifying transparency of the ocular media hinders visualization of the posterior pole and leads to low quality retinal images obtained using OCT. This may lead to false thickness measurements of the nerve fiber layer, which turns out to be thinner.

Frequently, the same patient suffers from cataracts associated with optic nerve pathologies such as glaucoma, and in such cases exploring RNFL thickness may prove relevant not only for the diagnosis but also during patient follow-up.

The pilot study was therefore designed to analyze the implications of cataract surgery when exploring RNFL thickness.

SUBJECTS, MATERIAL AND METHODOLOGY

Seventy-four eyes belonging to 74 patients to be subjected to cataract surgery were studied after signing an informed consent for both the procedure and the capture of images using OCT.

The study included patients not suffering from glaucoma or any other alterations of transparency of the ocular media. Similarly, patients whose intraocular pressure (IOP) range fell under 21 mmHg were also selected.

The procedure was performed by the same surgeon (M.A.T.) with phacoemulsification and intraocular lens implant (IOL) in the posterior chamber. Topical anesthesia was used. Incisions were performed on a clear cornea. All those cases for which short- and medium-term surgical complications were suspected were discarded.

Measurements were carried out by the same observer (J.P.E.). OCT III Stratus® (Carl Zeiss Meditec) was used and all measurements were performed under identical mydriasis conditions. Three explorations were completed prior to surgery, on the day after and one month later. Each of those explorations consisted of three measurements, choosing for analysis the one showing the best image quality signal.

For each measurement, an image of the peripapillary area in a 3.4-mm diameter was obtained using «Fast RNFL Thickness» software on OCT III Stratus®. In order to achieve perfect scanner centering, internal fixation was used in all cases.

Data related to RFNL average thickness were obtained using the analytical software supplied with the measuring device.

The results were statistically analyzed using the statistical software SPSS 12.0 for Windows (SPSS Inc., Chicago, Illinois, USA.) The «t for Student» test was applied to paired samples, results with p<0.05 being defined as statistically significant.

FINDINGS

The study group consisted of 74 eyes (38 right eyes; 36 left eyes) belonging to 74 patients (32 males, 42 females) whose average age was 71.62 (SD: 9.46) years.
RNFL peripapillary average thickness prior to cataract surgery (AVGT0) was 90.71 µm (SD: 19.93); the day after surgery (AVGT1) it stood at 88.30 µm (SD: 20.59); and one month later (AVGT2) it was 97.45 µm (SD: 14.30).

No statistically significant differences (p > 0.05) were found between AVGT0 and AVGT1; however, said difference was observed indeed between AVGT1 and AVGT2 (p=0.002) with greater RNFL average thickness one month after cataract surgery.

When analyzing RNFL behavior depending on peripapillary sectors, the results obtained for the superior and inferior sectors were particularly interesting (tables I and II).

In terms of image quality provided by OCT III Stratus® (Signal), results were 4.19 (SD: 1.92) in AVGT0 measurements; 4.84 (SD: 2.29) in AVGT1; and 4.92 (SD: 1.55) in the case of AVGT2. No statistically significant differences were observed as far as quality is concerned between the images obtained for AVGT0 and AVGT1, although the same differences were found when comparing AVGT0 and AVGT2 (p=0.001).

**DISCUSSION**

OCT is a non-invasive test that has proven very useful in highly accurate studies of macular pathology, since image resolution may reach 10µm; similarly, it has been useful in the diagnosis and follow-up of optic nerve pathologies.

Nevertheless, structural changes taking place in the posterior pole after completing routine surgical procedures such as lens phacoemulsification are relatively unknown, and OCTs are contributing to a better understanding of such changes.

Some authors such as Ching H-Y et al (1) found statistically significant differences consisting in greater foveal thickness and central retinal thickness prior to surgery and during weeks 2 and 8 after cataract surgery, while this tendency does not withstand for central retinal thickness during the fourth week.

Similarly, Biro Z et al. (2) found no significant increases in retinal, perifoveal or foveal thickness on the day after surgery. However, 30 days after the procedure, the increase was found to be significant.

Grewing and Becker (3) demonstrated that there were no differences between retinal macular thickness measured prior to and 30 minutes after cataract surgery.

As for peripapillary RNFL average thickness, El-Ashry et al (4) found a statistical significance favoring greater average RNFL thickness one month after completing cataract surgery on 24 patients. On the other hand, they found greater signal quality one month after surgery.

The positive correlation found between the signal increase measured based on the «Signal Strength» parameter and the increase in RNFL thickness has also been recently confirmed by several authors (8-10).

These findings match those obtained in the present study, although in this case evidence was avai-

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**Table I. RNFL peripapillary thickness behavior in superior sector**

<table>
<thead>
<tr>
<th></th>
<th>Average thickness</th>
<th>Comparison</th>
<th>Statistical significance (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA0</td>
<td>105.7 SD 27.15µm</td>
<td>SA0 vs. SA1</td>
<td>P=0.045</td>
</tr>
<tr>
<td>SA1</td>
<td>111.71 SD 29.33µm</td>
<td>SA1 vs. SA2</td>
<td>P=0.029</td>
</tr>
<tr>
<td>SA2</td>
<td>116.59 SD 22.07µm</td>
<td>SA0 vs. SA2</td>
<td>P=0.001</td>
</tr>
</tbody>
</table>

RNFL: retinal nerve fiber layer; SA0: pre-surgical superior RNFL thickness; SA1: superior RNFL thickness 24 hours after cataract surgery; SA2: superior RNFL thickness 1 month after cataract surgery.

**Table II. RNFL peripapillary thickness behavior in inferior sector**

<table>
<thead>
<tr>
<th></th>
<th>Average thickness</th>
<th>Comparison</th>
<th>Statistical significance (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA0</td>
<td>119.50 SD 27.82µm</td>
<td>IA0 vs. IA1</td>
<td>P=0.016</td>
</tr>
<tr>
<td>IA1</td>
<td>111.06 SD 31.71µm</td>
<td>IA1 vs. IA2</td>
<td>P=0.006</td>
</tr>
<tr>
<td>IA2</td>
<td>122.63 SD 24.18µm</td>
<td>IA0 vs. IA2</td>
<td>P=0.047</td>
</tr>
</tbody>
</table>

RNFL: retinal nerve fiber layer; IA0: pre-surgical superior RNFL thickness; IA2: superior RNFL thickness 1 month after cataract surgery.
lable to explain that such changes in peripapillary thickness cannot be observed 24 hours after surgery. It may be necessary to wait more than 24 hours after surgery for the factors involved in the increase of nerve fiber layers to become apparent (5).

However, when analyzing the superior and inferior peripapillary sectors, the results obtained were statistically significant starting in the first 24 hours. In the superior sector, a greater thickness was observed immediately after surgery, while the inferior sector experienced a reduction in thickness.

One month after surgery, the differences still favor a greater thickness in both sectors versus basal determination. Nevertheless, when analyzing the inferior sector, a weak statistical significance (p = 0.047) was found which may confirm that, in spite of the increase in thickness for the inferior fiber layer, differences prior and after surgery in this sector are minimal, thus rendering the parameter less dependent on image quality. This means these may be more reliable to study the optic nerve in cataract patients. The findings are particularly interesting when considering the use of studies of both sectors for the diagnosis of glaucoma using OCT (11).

The increase in average peripapillary RNFL thickness one month after surgery comes hand in hand with improved signal quality.

This finding may be explained by the decrease in corneal edema and corneal inflammation in the first 24 hours after surgery as well as lens removal, which may have an influence on the images obtained (6, 7).

More favorable conditions, such as transparency of the ocular media and absence of corneal inflammation one month after surgery, may explain why exploration of RNFL thickness at this time is more accurate, and therefore low Signal Strength levels may be used to measure the nerve fiber layer.

On the other hand, the study of other factors that may lead to the increase in the nerve fiber layer after surgery, such as post-surgical intraocular inflammation, may be of interest. In this sense, studies over a longer period of time monitoring RNFL behavior may provide more information, based on the hypothesis that such inflammation would take less time and the fiber layer would therefore be thinner. In these cases, factors affecting the signal, such as posterior capsule opacification, should be controlled for.

Therefore, the effects linked to the presence of cataracts ought to be taken into account both in those studies assessing changes in nerve fiber layer thickness with OCT and those interpreting cystoid macular edema outcomes after cataract surgery.

In clinical practice, changes obtained in RNFL measurements as a consequence of cataract surgery should be taken into consideration among those patients for whom OCT is used as a follow-up tool for underlying ocular pathologies.

Nevertheless, these findings are contingent upon studies with larger samples that may confirm more accurately the statistical differences observed. It is also worth mentioning that the present study is limited due to the poor quality of the images obtained, which is mainly due to the presence of cataracts.

REFERENCES