Effect of Phaco Time on Retinal Thickness

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Citation

Abstract
The present prospective study aimed to compare macular thicknesses measured by optical coherence tomography (OCT) before and after uncomplicated phacoemulsification and to investigate the effect of phaco time (PT) on postoperative macular thickness. The study included 65 eyes of 65 patients between February 2015 and September 2015. OCT measurements were performed preoperatively and at the postoperative 1st day, 1st week, and 1st month. The mean macular thickness measured at the postoperative 1st day was significantly higher than those measured preoperatively and at the postoperative 1st week and 1st month (p=0.027, p=0.037, and p=0.019, respectively). The mean peripheral superior quadrant macular thickness measured at the postoperative 1st day was significantly higher than those measured at the postoperative 1st week and 1st month (p=0.022 and p=0.048, respectively). The mean inferior quadrant macular thickness measured at the postoperative 1st day was significantly higher than that measured at the postoperative 1st month (p=0.032). The mean peripheral inferior quadrant macular thickness was significantly higher at the postoperative 1st day than at the postoperative 1st week (p=0.048). The mean peripheral nasal quadrant macular thickness measured at the postoperative 1st day was significantly higher than those measured at postoperative 1st week and 1st month (p=0.049 and p=0.048, respectively). There was a significant moderate correlation between the macular thickness measured at the postoperative 1st day and PT (Pearson’s correlation, rho=0.306 and p=0.013). No significant linear correlation was found between macular thicknesses of other quadrants and PT. The present study revealed significant changes in the macular thickness in special regional pattern in the parafoveal region and that PT had an increasing effect on the macular thickness in the early period but had no significant effect on the macular thickness in the long term.

1. Introduction

Phacoemulsification (phaco) is today the most common technique used for cataract surgery. In phaco, various factors may affect ocular tissue structures. Ultrasonic energy and fluids produce mechanical energy and this leads to inflammatory reaction, compression, and hypoxia in the tissue. Each step of this procedure may cause direct effect on the tissue or instant fluctuations of pressure. As fluids has a pressure effect that radiates like a miniature shock wave, it can directly affect the anterior chamber tissue and may conduct this effect in every direction. Ultrasonic energy should also be taken into consideration as a risk factor that could affect the eyeball structures [1-5].

The retina, a sensory array, is in need of more oxygen as compared to the brain and
phacoemulsification in healthy individuals has been reported. All OCT examinations were performed by experienced technicians. Only the reliable OCT maps clearly showing the retinal margins were chosen. Retinal maps were divided into three segments: foveal (central), inner (paracentral) and outer (peripheral). Inner and outer segments were divided into four quadrants as superior, inferior, temporal, and nasal. The OCT examinations of the patients were performed preoperatively and at the postoperative 1st day, 1st week, and 1st month.

2.1. Surgical Procedure

All surgical procedures were performed by the same surgeon (HK) using peristaltic phaco device (Signature®, Abbott IL, USA). The Leica F19 (Wetzlar, Germany) with halogen light was used as the surgical microscope. Prior to the surgery, 1% tropicamide, 1% cyclopentolate, 2.5% phenylephrine hydrochloride, and 0.3% ofloxacin was dropped into the eyes of all patients for 4 times at 10-min intervals. Topical anesthesia was performed before the surgery. Standard steps of phacoemulsification procedure including 2.8 mm corneal tunnel, capsulorhexis, hydrodissection, bimanual phacoemulsification and irrigation/aspiration of the residual cortex, and endcapsular lens (Alcon) implantation were performed. At the end of the surgery, 0.1 mL cefuroxime was injected into the anterior chamber. In the present study, ultrasonic energy was measured as PT and PT was recorded for each surgical procedure.

In the postoperative period, the patients used 0.3% ofloxacin at a daily dose of 5x1 drop for 15 days, 1% prednisolone acetate at a daily dose of 5x1 drop for 20 days, and 0.1% nepafenac at a daily dose of 4x1 drop for 20 days. Patients who developed intraoperative or postoperative complications were excluded from the study. The patients were examined at the postoperative 1st day, 1st week, and 1st month.

2.2. Statistical Analysis

Descriptive statistics for age and PT were expressed as mean, standard deviation, and minimum and maximum. Distribution of gender was expressed as number and percentage. The difference between the measurements performed at different time points was analyzed by the model of repeated measures analysis of variance. Significant differences were evaluated by post hoc test with Bonferroni correction. A p value of <0.05 was considered significant. The data analyses were performed using the Predictive Analytics Software (PASW) Statistics (version 18; SPSS Inc., Chicago, IL, USA). Pearson’s correlation analysis was used for relationship between macular thickness and PT.

3. Results

Uncomplicated phacoemulsification surgery was performed in 65 eyes of 65 patients with a mean age of 65.43±9.51 years (range, 35.0-80.0 years). Of the patients, 36
(55.4%) were male and 29 (44.6%) were female. None of the patients had a history of cataract surgery. The mean PT was 23.797±9.39 s (range, 12.5-44.6 s).

The mean intraocular pressure (IOP) values measured at different time points are presented in Table 1. There was a significant difference among the IOP values measured at different time points (p=0.006). The mean IOP value measured at the postoperative 1st day was significantly higher than those measured preoperatively and at the postoperative 1st week. (p=0.049 and p=0.014, respectively); however, no significant difference was determined between the mean IOP values measured preoperatively and at the postoperative 1st week.

<table>
<thead>
<tr>
<th>IOP</th>
<th>Mean±SD (mmHg)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>17.16±3.4757</td>
<td></td>
</tr>
<tr>
<td>Postoperative 1st day</td>
<td>18.96±5.4885</td>
<td>0.006</td>
</tr>
<tr>
<td>Postoperative 1st week</td>
<td>16.76±3.0658</td>
<td></td>
</tr>
</tbody>
</table>

* significantly different from the IOP values measured preoperatively and at the postoperative 1st week.

IOP, intraocular pressure; SD, standard deviation.

The measurements of the macular thickness obtained from the central, paracentral, and peripheral segments at the preoperative and postoperative periods are demonstrated in Table 2. There was a significant difference among the mean central macular thicknesses measured at different time points (p=0.023). The mean central macular thickness measured at the postoperative 1st day was significantly higher than those measured preoperatively and at the 1st week and 1st month (p=0.027, p=0.037, and p=0.019, respectively). A significant difference was determined among the mean macular thicknesses of the peripheral superior quadrant measured at different time points (p=0.006). The mean peripheral superior quadrant macular thickness measured at the postoperative 1st day was significantly higher than those measured at the postoperative 1st week and 1st month (p=0.022 and p=0.048, respectively). A significant difference was determined among the mean inferior quadrant macular thicknesses measured at different time points (p=0.032). The mean inferior quadrant macular thickness measured at the postoperative 1st day was significantly higher than that measured at the postoperative 1st month. Comparison of the mean peripheral inferior quadrant macular thicknesses measured at different time points revealed a significant difference (p=0.016). The mean peripheral inferior quadrant macular thickness measured at the postoperative 1st day was significantly higher than that measured at the postoperative 1st week (p=0.048). There was a significant difference among the mean peripheral nasal quadrant macular thicknesses measured at different time points (p=0.007); the mean peripheral nasal quadrant macular thickness measured at the postoperative 1st day was significantly higher than those measured at postoperative 1st week and 1st month (p=0.049 and p=0.048, respectively). In the other quadrants, no statistically significant differences were observed among the retinal thicknesses measured at different time points.

Pearson’s correlation analysis revealed that only the central macular thickness measured at the postoperative 1st day significantly increased with an increase in PT; however, the correlation was moderate (rho=0.306 and p=0.013; Figure 1). No significant linear correlation was found between macular thicknesses of other quadrants and PT. The graphic of significant correlation is given below (Figure 1).

**Figure 1.** Relationship between phaco time and central macular thickness at the postoperative 1st day.

<table>
<thead>
<tr>
<th>Macular thickness (μm)</th>
<th>Preoperative (mean±SD)</th>
<th>Postoperative 1st day (mean±SD)</th>
<th>Postoperative 1st week (mean±SD)</th>
<th>Postoperative 1st month (mean±SD)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>245.24±28.81</td>
<td>269.33±89.05</td>
<td>246.30±27.52</td>
<td>242.09±43.41</td>
<td>0.023</td>
</tr>
<tr>
<td>Superior</td>
<td>307.67±48.26</td>
<td>325.44±94.36</td>
<td>301.24±26.72</td>
<td>303.03±25.03</td>
<td>0.077</td>
</tr>
<tr>
<td>Inferior</td>
<td>304.70±67.48</td>
<td>318.07±109.09</td>
<td>292.49±22.95</td>
<td>286.06±41.75</td>
<td>0.032</td>
</tr>
<tr>
<td>Temporal</td>
<td>288.55±49.02</td>
<td>300.96±96.14</td>
<td>282.78±26.56</td>
<td>280.90±29.46</td>
<td>0.119</td>
</tr>
<tr>
<td>Nasal</td>
<td>308.12±66.02</td>
<td>331.89±109.99</td>
<td>305.58±23.44</td>
<td>302.69±37.42</td>
<td>0.060</td>
</tr>
<tr>
<td>Peripheral superior</td>
<td>283.81±31.25</td>
<td>296.18±61.62</td>
<td>274.72±25.44</td>
<td>276.92±19.60</td>
<td>0.006</td>
</tr>
<tr>
<td>Peripheral inferior</td>
<td>275.84±35.69</td>
<td>290.93±66.95</td>
<td>272.21±20.99</td>
<td>267.53±34.23</td>
<td>0.016</td>
</tr>
<tr>
<td>Peripheral temporal</td>
<td>272.44±41.61</td>
<td>280.43±62.49</td>
<td>266.29±22.25</td>
<td>268.20±24.31</td>
<td>0.080</td>
</tr>
<tr>
<td>Peripheral nasal</td>
<td>297.90±30.79</td>
<td>311.90±58.98</td>
<td>291.76±20.86</td>
<td>290.76±34.79</td>
<td>0.007</td>
</tr>
</tbody>
</table>
4. Discussion

Phaco is currently the most commonly used technique to remove the cataract lens using ultrasonic energy. Many studies have shown that phaco provides satisfactory outcomes for patients and is a safe surgery. Phaco-related changes in foveal thickness have also been reported [1]. In the present study, an increase in the retinal thickness in the macular region was observed at the postoperative 1st day. Moreover, a progressive decrease in the retinal thickness was observed in different patterns in the central fovea and outer macular regions after the 1st week of surgery.

In the previous studies, subclinical macular thickening after uncomplicated cataract surgeries have been reported. There are studies reporting a decrease in the retinal thickness at the postoperative 1st day as compared to the opposite eye [7]. In the present study, an increase was determined in the retinal thickness in the macular region. While two studies determined significant increase in the retinal thickness at the postoperative 1st day, one other study determined moderate decrease and another study determined significant decrease [7, 24-26]. Change, or increase, in the retinal thickness following cataract surgery seems to be associated with surgery-related inflammation in the short term. The decrease in the retinal thickness in some studies might be associated with the effect of lens opacities on the preoperative OCT analyses. In fact, cataract may have light-scattering effect [27]. This can lead to artifacts in OCT measurements. When all these factors are taken into account, the postoperative 1st-day measurements may be considered real baseline retinal thickness.

In the present study, the mean central macular thickness measured at the postoperative 1st day was significantly higher than those measured preoperatively and at the postoperative 1st week and 1st month. The mean peripheral superior quadrant macular thickness measured at the postoperative 1st day was significantly higher than those measured at the postoperative 1st week and 1st month. It was observed that the mean inferior quadrant macular thickness measured at the postoperative 1st day was significantly higher than that measured at the postoperative 1st month. The mean peripheral inferior quadrant macular thickness was significantly higher at the postoperative 1st day than at the postoperative 1st week. The mean peripheral nasal quadrant macular thickness measured at the postoperative 1st day was significantly higher than those measured at the postoperative 1st week and 1st month. Lobo et al. [28] investigated the retinal leakage following uneventful phacoemulsification surgery using a prototype of confocal scanning laser fluorometer and determined retinal leakage in the perifoveal area in all patients (97%), except for one eye. These areas of leakage might be the areas at which the blood-retinal barrier is focally disrupted in the vascularized areas of the macula outside the foveal avascular area. This condition might explain the patterns of regional macular thickness observed in the present study.

In the present study, a significant increase in the central macular thickness measured at the postoperative 1st day was observed with an increase in the PT; however, this was a moderate correlation. No significant correlation was found between other macular thickness measurements and PT. The results revealed no relation between PT and macular thickness in the late term suggesting that ultrasonic energy radiating over retinal structures is low and phaco is safe for retinal structures.

In a study, a moderate correlation between absolute PT and macular volume was demonstrated [1]. This indicates that macular volume is sensitive to ultrasonic energy. Although ultrasonic energy is safe for macular structures, energy overuse should be avoided. Distribution of the ultrasonic energy and its effect on macular volume should be minimized.

5. Conclusion

In conclusion, OCT provides objective and repeatable measurements of macular thickness and allows determination of postoperative changes in retinal thickness. The present study revealed significant changes in the macular thickness in special regional pattern in the parafoveal region and that PT had an increasing effect on the macular thickness in the early period but had no significant effect on the macular thickness in the long term.

References


