RESEARCH ARTICLE

EVALUATION OF CENTRAL MACULAR THICKNESS AFTER PHACOEMULSIFICATION IN NON-DIABETIC PATIENTS MORE THAN 40 YEARS OLD

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ABSTRACT

**Purpose:** To assess the central macular thickness after phacoemulsification surgery.

**Methods:** Twenty eyes of 15 non-diabetic, more than 40 years old patients, who underwent uncomplicated phacoemulsification, central macular thickness using swept source optical coherence tomography was estimated preoperatively and four weeks postoperatively.

**Results:** The central macular thickness increased with highly significant degree from \((248.35 \pm 30.10)\) preoperative to \((271.90 \pm 36.49)\) four weeks postoperative \((p=0.006)\), only one eye developed cystoid macular edema representing 5% of patients. There was high significant improvement of visual acuity. The BCVA increased highly significant from \(0.67 \pm 0.21\) on log MAR preoperatively to \(0.38 \pm 0.23\) week postoperatively and to \(0.24 \pm 0.23\) four weeks postoperatively \((p=0.000)\).

**Conclusion:** There was a significant increase in CMT 4 weeks postoperatively.

INTRODUCTION

Macular oedema occurs when fluid and protein deposits collect within the macula, leading to thickening and swelling which distorts central vision. It is a common final pathway for many ocular diseases, including diabetes mellitus, vascular occlusions, postsurgical conditions and uveitic diseases (Coscas et al., 2010). The occurrence of pseudophakic macularedema peaks at approximately 4-6 weeks postoperatively. The most common presentation is blurry vision; less common presentations include central scotomas, metamorphopsia, and mild photophobia (Gabriel et al., 2010). Foveal thickness for normal subjects was measured to be \(229\pm20.46\ \mu m\) and never exceeded \(252\ \mu m\) in any of the healthy eyes, central foveal thickness is \(182 \pm 23 \ \mu m\) in the healthy eyes (Annie et al., 2006). One of the causes of macular edema is replacement of the lens as treatment for cataract which can cause pseudophakic macular edema, also known as Irvine-Gass syndrome. This surgery sometimes irritates the retina (and other parts of the eye) causing the capillaries in the retina to dilate and leak fluid into the retina (Ecsedy et al., 2011).

The pathophysiology of cystoid macular edema (CME)

The vitreous, retina, retinal pigment epithelium and choroid receive their circulation through the retinal and choroidal vasculature. This relies upon an intrinsic balance amongst the osmotic force, hydrostatic force, capillary permeability and tissue compliance in the vasculature. Once imbalance occurs, an accumulation of fluid is seen in cystoid spaces within the inner layers of the retina. Vitreomacular traction is a common underlying factor which contributes to the release of inflammatory factors such as vascular endothelial growth factor (VEGF) and platelet-derived growth factor. This results in the blood–retinal barrier (BRB) breakdown, leakage and edema (18). In 1953, Irvine described a cystoid macular edema that specifically arises after cataract surgery. Approximately 20% of the patients who undergo uncomplicated phacoemulsification develop angiographically proven CME. However, a clinically significant decrease in visual acuity is seen only in about 1% of these eyes (17).

PATIENTS AND METHODS

This study included 20 eyes of 15 non-diabetic more than 40 years old patients. All patients were admitted for Phacoemulsification cataract surgery and foldable posterior chamber IOL implantation at Bab Al-Sharia University Hospital.
Methods of ocular examination

1. **Thorough history taking including**: Age, sex, detailed visual complaints, past ocular history (disease & surgery) and other associated systemic diseases.

2. **Ocular examination**: Best corrected visual acuity (BCVA) in Snellen's line formatting was done preoperatively and then at 4 weeks. Preoperative anterior segment examination with slit lamp biomicroscopy to assess cataract density. Measurement of intraocular pressure (IOP) with air puff. Preoperative fundus examination with slit lamp biomicroscopy with the +90 D lens to assess macular status and peripheral retina.

3. **Optical coherence tomography**: Pupils were dilated for OCT examination in all cases with 1% tropicamide (Mydracil). OCT was done preoperatively and then 4 weeks postoperatively. OCT using TOPCON DRI OCT Triton (plus) Swept source OCT, 1050 nm wave length. Retinal thickness was measured with radial lines (16 lines overlap). The scan Diameter is 6.0mm. It consists of two circular maps divided into nine areas centered on macula of each eye. Only mean foveal thickness was studied; which represents the mean thickness of a foveal area of a diameter of 1000 μm (1mm).

**Inclusion criteria:** Any degree of cataract, age more than 40 years and macula free clinically and by OCT.

**Exclusion criteria include:** Diabetic patients, hypertensive patients, glaucomatous patients and uveitic patients.

**Phacoemulsification procedure**: Phacoemulsification and intraocular lens insertion were performed using almost the standard techniques. Before surgery, all pupils were dilated with 1% tropicamide (Mydracil), also ocular sterilization with povidine iodine 5% was used. Cataract surgery was performed under local anaesthesia, anterior limbal scratch incision was made with 1% tropicamide (Mydriacyl). OCT was done preoperatively and then under local anaesthesia, anterior limbal scratch incision was made with 1% tropicamide (Mydriacyl).

All patients were older than 40 years with cataracts (nuclear II and faint posterior subcapsular) that still permitted almost clear fundal examination.

### Table 1. Comparison between preoperative, 1week and 4weeks postoperative best corrected visual acuity

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>1week post operative</th>
<th>4weeks post operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best corrected visual acuity (LogMAR)</td>
<td>Mean ± SD</td>
<td>0.67 ± 0.21</td>
<td>0.38 ± 0.23</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>1.3 – 0.00</td>
<td>0.76 – 0.00</td>
</tr>
</tbody>
</table>

P > 0.05: Non significant P < 0.05: Significant, P < 0.01: Highly significant

### Table 2. Comparison between preoperative and 4weeks postoperative central macular thickness

<table>
<thead>
<tr>
<th>Central macular thickness (µ)</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>248.35 ± 30.10</td>
<td>271.90 ± 36.49</td>
<td>t = -3.094, P = 0.006</td>
</tr>
<tr>
<td>Range</td>
<td>194 – 298</td>
<td>202 – 356</td>
<td></td>
</tr>
</tbody>
</table>

The CMT increased with highly significant degree from (248.35 ± 30.10) preoperative to (271.90 ± 36.49) four weeks postoperatively (p=0.006).

### Table 3. Correlation between CMT changes groups and ages of the patients

<table>
<thead>
<tr>
<th>Changes of CMT &amp; Age</th>
<th>&lt;10µm</th>
<th>10-30 µm</th>
<th>&gt;30 µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>53.6 ± 6.23</td>
<td>52.58± 8.94</td>
<td>58± 4.08</td>
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<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

### Table 4. Correlation between postoperative 4weeks CMT with phaco time

<table>
<thead>
<tr>
<th>Phaco time (min.)</th>
<th>Central macular thickness (µ)</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>t = -0.186</td>
<td>0.433</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

r = Correlation coefficient.
There is no significant correlation between postoperative 4weeks CMT with phaco time as (P > 0.05).

### Table 5. Correlation between adrenaline use with 4weeks postoperative CMT

<table>
<thead>
<tr>
<th>Central Macular thickness (µ)</th>
<th>No</th>
<th>Yes</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>269.83 ± 31.30</td>
<td>275.00 ± 45.36</td>
<td>-0.303</td>
<td>0.766</td>
</tr>
<tr>
<td>Range</td>
<td>202 – 317</td>
<td>226 – 356</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is no significant correlation between adrenaline use with 4weeks postoperative CMT as (P>0.05).

### Table 6. Correlation between U/S phaco type with 4weeks postoperative CMT

<table>
<thead>
<tr>
<th>U/S Type</th>
<th>Phaco (longitudinal)</th>
<th>Phaco (Torsional)</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central macular thickness (µ)</td>
<td>Mean ± SD</td>
<td>269.36 ± 43.63</td>
<td>275.00 ± 27.65</td>
<td>-0.335</td>
</tr>
<tr>
<td>Range</td>
<td>202 – 356</td>
<td>226 – 317</td>
<td></td>
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</tr>
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</table>

There is no significant correlation between U/S phaco type with 4weeks postoperative CMT as (P>0.05).
made using keratome, two side ports was made by micro vitreo-retinal plade (MVR). Use of epinephrine solution with eight patients. Formation of the anterior chamber by viscoelastic material. Capsulorhexis was performed under viscoelastic material. Hydrodissection and hydrodelineation. Phacoemulsification of the nucleus. Computing of phaco time. Bimanual irrigation aspiration. Implantation of foldable intraocular lens in the bag by injector through the wound. Finally hydration of the wound and the 2 paracentesisopenings. After the operation all patients received the same standard medication, consisting of a combination of steroidal eye drops (Prednisolone acetate), 1 drop every 6 hours for 1 week, then 1 drop every 8 hours for 2 weeks, then 1 drop every 24 hours for 1 week and antibiotic (Gatifloxacin) eye drops 4 times daily for 10 days.

**Follow up**

Clinical examination at one week and one month postoperatively including best corrected visual acuity and fundus examination. OCT was done at 4 weeks postoperatively.

**RESULTS**

This study was conducted on 20 eyes of 15 non-diabetic more than 40 years old subjects who underwent uneventful phacoemulsification and posterior chamber foldable IOL implantation. The mean age was 53.65 ± 8.20. They were 8 females and 12 males. The following table No. (1) is showing comparison between preoperative, 1 week and 4 weeks postoperative BCVA. The BCVA increased with highly significant degree from 0.67 ± 0.21 on logMAR to 0.38 ± 0.23 one week postoperatively and 0.24 ± 0.23 four weeks postoperatively (p=0.000).

Central macular thickness (CMT), which represents area of a diameter of 1000 μm (1mm), was studied preoperative and four weeks postoperative using OCT. The following photo Fig. No. (2) is showing cystoid macular edema (CME) of a patient of this study which represents 5% of total study cases. The following Table No. (5) shows correlation between intraoperative adrenaline use (intracameral epinephrine) with 4 weeks postoperative CME. The following Table No. (6) Shows correlation between U/S phaco type with 4 weeks postoperative CMT.
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 (Mohamed, 2014). The incidence of subclinical macular edema after uneventful cataract surgery has become a safety issue for this frequent operation, as studies have found angiographic leakage up to 19% postoperatively with OCT, which it's peak is detectable 4 to 6 weeks after surgery, in pseudophakic eyes (Gabriel et al., 2010). In present study, the investigation of the effect of phacoemulsification on central macular thickness was measured by swept source OCT, and the results indicate that there is highly significant increase in thickness from 248.35 ± 30.10μm preoperative to 271.90 ± 36.49 μm at four weeks after cataract surgery. Although present study included a small group (only 20 eyes), it is assumed that data reliability is high because of the homogeneous nature of the patients (similarities of age, cataract type and severity, phaco time and so on) and the careful/detailed OCT examinations performed by one investigator. Torkey (2012) evaluated the effect of phacoemulsification on central macular thickness and her sample group was on 25 eyes and the result was a highly significant increase in thickness from 208.7 ± 41.0 preoperatively to 232.9 ± 35.6 4weeks postoperative. Present results support the recent studies by Altintas et al. (2012) showed that there was a mean change in CMT 1.8 ± 8.8μm between postoperative 4weeks CMT statistically significant result which reported significant increases in CMT after uneventful phacoemulsification. But Protasio & Agular (2016) showed that there was a mean change in CMT 1.8 ± 8.8μm (p=0.44) which is not significant, which is on the contrary of this study which may be due to race difference because that study was carried out in Philippine. The ages of the patients were not significantly correlated to changes in CMT. Also, Gharbiya et al. (1953) and Torkey (2012) had no statistically significant result between ages of the patients and changes in CMT. In present study the only patient who had developed CME in his second operated eye may be due to hypersensitivity from lens material sensitization due to phaco manipulation during his first eye surgery 27 days before, but it is still a weak probability as other four patients in this study made also their second eye after the first eye by variety from 14-48 days and had not developed CME. The BCVA improvement was highly significant from 0.67 ± 0.21 on log MAR to 0.38 ± 0.23 at one week postoperatively and to 0.24 ± 0.23 at four weeks postoperatively (p-value = 0.000). Also Akçay et al. (2012), Nagy et al. 2016 and Celik et al. 2010 Showed that BCVA was improved significantly after one week postoperatively. Also Akçay et al. (2012), Nagy et al. 2016 and Celik et al. 2010 Showed that BCVA was improved significantly after four weeks postoperatively. The mean phaco time in present study was (1.43 ± 0.23 min) and there is no significant correlation between postoperative 4weeks CMT statistically (P> 0.05). Surbhi et al. 2012; Gharbiya et al. 1953, Koç et al. 2014 and Altintas et al. 2016 Showed that there was no significant correlation between found between 4weeks postoperative CMT measurement and phaco time (PT). There was no significant correlation between adrenaline use with 4 weeks postoperative CMT (P>0.05). Also Johansson et al. 2016 and Bozkurt et al. 2016 had no statistically significant result between adrenaline use and 4 weeks postoperative CMT. Regarding U/S phaco type and 4weeks postoperative CMT neither torsional nor longitudinal types had significant correlation between U/S phaco type with 4weeks postoperative CMT (P=0.05), Surbhi et al. 2012 also reached to the same conclusion.

REFERENCES


Torky Z.A. 2012. Evaluation of macular changes after uneventful phacoemulsification surgery in diabetic patients using optical coherence tomography, Ophthalmology department, Faculty of medicine, Cairo University, Cairo, Egypt, 2: 5-88.

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