

Changes in central Macular Thickness after Uncomplicated Phacoemulsification in Diabetic versus Non-Diabetic Patients using optical Coherence Tomography (OCT)

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Abstract

Aim: - The aim of this study is to compare central macular thickness changes after un complicated phacoemulsification in diabetic versus Non diabetic patients by using optical coherence tomography (OCT).

Patient and Methods: This prospective comparative randomized study included 50 eyes who were scheduled for cataract surgery by phacoemulsification in ophthalmic department, Sohag university Hospital ,in period from March 2016 to June 2017. These patients were divided into two main groups ,Group1 includes 25 eyes for diabetic patients and Group 2 includes 25 eyes for non diabetic patients. A comparison between two groups was done. The following was done for each patient in this study

Detailed history including age, gender, presence of diabetes and its duration, history of previous ocular surgery, history of previous treatment in diabetic patients..

.Conclusion: Our results suggest that Diabetes influences the central macular thickness in diabetic patients, who are more liable to changes in central macular thickness after cataract surgery even if uncomplicated

OCT is valuable, non invasive , reproducible device to detect Pre&Post operative changes in macular thickness and it represents the single most important diagnostic and prognostic tool in management of macular oedema .

Introduction:

Phacoemulsification (phaco) is one of the most widely used cataract surgery techniques nowadays. Various factors involved in phaco can influence the tissue structures of the eyeball. Unlike other maneuvers, ultrasonic energy and fluidics produce mechanical effects that cause an inflammatory reaction, compression, and hypoxia on the tissue. Every step of this maneuver can cause direct effects on tissue and instantaneous pressure fluctuation. Fluidics also has radiating pressure effects which resemble a miniature shock wave and jet

stream that point directly onto the anterior chamber tissue and are forwarded in all directions. Ultrasonic energy should also be taken into account as a risk factor that may affect the structure of the tissue in the eyeball.

The macula is an important structure in charge of the 30-degree field of view, which greatly determines the quality of sharp vision, communication, interpersonal relationships, and color vision, including contrast sensitivity. The central macula has been widely studied, and is closely related to the

function of the fovea in visual acuity and color vision. The retinal nerve fiber layer (RNFL) has been of great interest in relation to the peripheral visual field, and the paracentral and peripheral macula.

Cystoid macular edema (CME) is the formation of fluid-filled spaces between the outer plexiform and inner nuclear layers of the retina, resulting from disruption of blood retinal barrier. It is a common complications observed after cataract surgery, with or without other complications. The rate of cystoid macular edema increases in the presence of diabetic retinopathy and uveitis. Although the pathogenesis is still not fully understood the diagnosis is usually confirmed by clinical or angiographic examination, with modern surgical techniques the incidence of (CME) has been decreased

OCT is a new diagnostic tool, which gives a high-resolution cross-sectional image about the change of the retina and chorioidea in the living structure (in vivo). The eye is illuminated with a near-infrared light, the technique is noninvasive. Since it is a so-called 'noncontact' method, it is well tolerated by the patients. It is mainly useful in the examination of the changes of the anatomical structures of the macular area (oedema, chorioideal neovascularisation, a retinal pigmentepithel detachment, detachment of the neurosensory retina), and in the examination of the disorders of the vitreoretinal surface (such as vitreomacular traction, epiretinal membrane).For detecting macular edema, OCT is superior to contact lens biomicroscopy and fluorescein angiography

Patients and Methods

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Detailed history including age, gender, presence of diabetes and its duration, history of previous ocular surgery, history of previous treatment in diabetic patients.

Full ophthalmological examination including Measuring visual acuity (VA) best corrected visual (BCVA), Examination of anterior segment of the eye by slit lamp biomicroscopy., Intraocular pressure (IOP) measurement using applanation tonometer. and Examination of fundus (if possible) by auxiliary lens and indirect ophthalmoscope and/or +78D Volkman to detect any retinal or macular pathology.

Surgical procedure:

All surgeries underwent a standard phacoemulsification procedure using INFINITI R vision system (Alcon) phaco machine (Fig5-1), in ophthalmology department, Sohag university hospital.

Preoperative preparation of patients

Instillation of cyclopentolate hydrochloride (HCL) 1% eye drops (cicloplejico) to gain full pupillary dilatation.

All operations were done under both facial and retobulbar anaesthesia using Xylocaine 2%.

The standard phacoemulsification steps included:

a-Clear corneal incision by keratome 2,4mm was made and 2 sideports by MVR20 gauge.

B-Injection of intra bagal viscoelastic and continuous capsulorehexis done by both capsulorehexis forceps or with bent insulin needle

c-hydrodissection and hydrodelineation of nucleus was done,

d-Phacoemulsification done successfully for all patients mainly Divide and conquer ,Stop and chop techniques were the main techniques of phacoemulsification.

e-Automated bimanual irrigation aspiration of cortical matter after removal of all nuclear quadrants was used,

f-The capsular bag inflated by 1.4% sodium hyaluronate after which Acrylic intraocular lens implanted in the bag through main corneal incision

g-Removal of viscoelastic by automated I/A, Stromal hydration of both main incision and 2 sideports was done
 OCT evaluatin:

We used Topcon,3D OCT-1 Maestro machine(Fig 5-2) to perform macular

Results:

The macular thickness was measured before & after surgery at 1,3,6 months in both groups.The central macular thickness and macular volume was measured by spectral domain Topcon,3D OCT-1 Maestro machine.

Results of our study will be mentioned as follow:

- o Results of group I diabetic patients.
- o Results of group II non diabetic patients.
- o Comparison between both groups

A comparison between pre and post operative macular thickness in groupI (diabetics) as follow:

Group	Mean	SD	Median	Range	Minimum	Maximum
Pre op	236.56 um	21.585	235	76	208	284
1m post op.	245.40 um	43.241	240	220	212	432
3m _s postop.	248.78 um	44.901	246	174	206	350
6m _s postop.	254.25 um	36.123	240	140	210	380

scan one day preoperative and then 1,3 and 6 months postoperative to measure central macular thickness and macular volume,before OCT examination Pupils were dilated in all cases by ,5% tropicamide

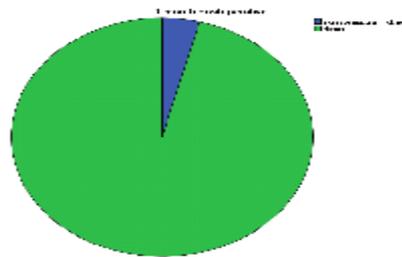
(Mydriacyl,Alcon),Examinations were performed in foveal and parafoveal zones and OCTmeasurements implemented through six radial scans centered on fovea,which produced fovea in central circular zone with superior,nasal,inferior,temporal parafoveal zones

Statistical analysis

Data was analysed using STATA intercooled version 12.1and Quantitative data was represented as mean,median,standard deviation,median,range.Qualitative data was presented as number and percentage which compared using chi square test.Groups were produced by using Excel or STATAprogrm.Pvalue considered significant if it was less than 0.05.

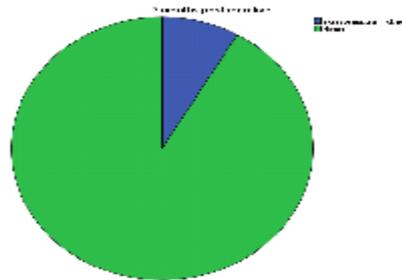
A comparison between pre and post operative macular thickness in groupII (Non diabetics)

	Preop.	1m postop.	3m _s postop.	6m _s postop.
Mean	231.88um	236.16um	236.28um	246.80um
Median	236.00um	241.00um	230.00um	245.00um
SD	19.147	13.912	16.903	21.459
Range	62	46	55	71
Minimum	202	219	214	210
Maximum	264	265	269	281



Group I (Diabetic)

Pie chart showing percentage of patients develop macular oedema after 1 month



Pie chart showing percentage of patients develop macular oedema after 3 months

Discussion:

In this study, we found that the OCT is a good noninvasive device to detect subclinical macular thickening in case of unexplained poor visual results after an uneventful cataract surgery.

Macular edema is a nonspecific retinal sign that may occur in association with certain systemic conditions, ocular diseases and after ocular procedures. It invariably leads to macular thickening and consequent worsening of vision. In diabetics, it occurs as a result of micro vascular changes in the retina influenced by several factors including blood sugar levels. In post-cataract surgery patients, inflammation plays an important role in its pathogenesis.

One of the most common causes of post cataract surgery decrease in visual acuity is Cystoid Macular Edema (CME). Progressive decrease in size of the incision for the extraction of opacified lens along with minimum handling of tissues due to improved surgical techniques have decreased the incidence of CME in skilled hands. Angiographic CME is approximately 50 to 75% after ICCE and is up to 20 to 30% after conventional ECCE. It is up to 19% after phacoemulsification (phaco), but angiographic CME doesn't necessarily reduce the visual acuity. Studies have reported that the occurrence of CME varies between 1.5 to 2.3% for phaco. There are many recognised and

suspected risk factors for the development of CME like diabetes mellitus, iris trauma and posterior capsular tear, etc. There are also many proposed mechanisms for the development of post cataract surgery CME, but the most accepted mechanism appears to be prostaglandin-induced oedema.

In this study we found that there is difference in central macular thickness after uneventful phacoemulsification between diabetic and Non-diabetic patients in comparison to preoperative values with increased incidence of macular edema in diabetic patients.

Various studies report an increased incidence or progression of macular edema in diabetic patients following lens extraction, with a peak at 1 month post-operatively. Most cases are transient, lasting for around 6 months, although it may persist or progress in some cases. There is conflicting evidence as to the significance of glycemic control on the macula of diabetic patients following cataract surgery. Studies by Flesner et al. and Romero-Aroca et al. looked at diabetic patients undergoing monocular phacoemulsification with the fellow eye serving as control. The status of the macula following cataract surgery was assessed using various methods (slit lamp bio microscopy and fluorescein angiography) and results revealed no significant association with HbA1c. However, a study by Hayashi et al. yielded conflicting results.

In a review study by Rotsos et al. it was suggested that cataract surgery in diabetic patients might accelerate preexisting diabetic macular oedema leading to poor visual outcome. Some other researchers suggested that even in the absence of diabetic macular oedema, diabetic patients tend to have a higher

risk of developing CME after uncomplicated cataract extraction. (86)

Regarding the diabetic group in our study we found that the mean of macular thickness in our diabetic patients was $236.5 \pm 21.5 \mu\text{m}$ preoperative, there was mild increase in mean of macular thickness 1,3 months postoperative, after 6 months. postoperative mean of macular thickness was $245.40 \pm 43.2 \mu\text{m}$ after 1 month and one diabetic patient (4%) developed macular edema, postoperative mean of macular thickness after 3 months was $248.78 \pm 44.9 \mu\text{m}$ and 2 patients (8.3%) developed macular oedema, and postoperative mean of macular thickness after 6 months was $254.25 \pm 36.1 \mu\text{m}$ and also 2 patients (9.1%) developed macular oedema after 6 months. This mean that 20% of our diabetic patients develop macular edema at different times after phacoemulsification. This was closely similar to Kwon et al. (81) who reviewed records of 104 diabetic patients who underwent cataract surgery. They examined changes of macular thickness using OCT before cataract surgery and 1 week, 1 month, 2 month and 6 month after surgery. The incidence of macular oedema in diabetic patients was 18%. Its peak incidence was at 1 month post surgery and it resolved spontaneously in 68% of patients by 6 months post-surgery.:

Our results were also confirmed by Tsilimbaris et al. as they conducted a study in their institution where they prospectively examined macular thickness alterations after uncomplicated phaco in four different groups of patients. One group consisted of otherwise fit patients while the others included patients with diabetes, epiretinal membrane and glaucoma. They concluded that regardless of group, a statistically significant Mean Foveal

Thickness (MFT) increase occurs one month after surgery, while this increase regresses six months after surgery. With regard to diabetic patients, these showed the greatest difference between postoperative and preoperative macular thickness indicating that the underlying pathophysiology is influenced significantly by the cataract extraction process. Despite these macular alterations, visual acuity improved significantly after cataract surgery in all patients in this study, while none of the patients showed clinical CME.

In study of Krepler et al. (90), macular edema occurred in 19 eyes (18%) which close to our results and improved spontaneously by 6 months in 68% of eyes. Its peak incidence was at 1 month post-surgery, which is similar compared to previous reports

When comparison was made between diabetic and non-diabetic group show that preoperative $p=0.007$, 1month postoperative $p=0.005$ and 3months postoperative $p=0.02$ and 6months postoperative $p=0.003$. These results show that mean of macular thickness was higher in diabetic patients than non-diabetic patients, this was in each preoperative, 1, 3, and 6 months after phacoemulsification, and this difference was significant, this was similar to Hayashi et al. as they report an increase in foveal thickness greater in eyes with diabetic retinopathy than in those without. This is attributed to the release of cytokines from the blood-ocular barrier after surgery, coupled with the increased breakdown of the blood-ocular barrier in diabetic eyes, also in their cohort of study eyes had a greater change in CMT ($16.7 \pm 18.5 \mu\text{m}$) compared to the cohort of control eyes ($1.8 \pm 8.8 \mu\text{m}$) which was statistically significant at $p=0.011$. They observed the role of

surgery in the cohort of study eyes because any change in the fellow eye would be assumed to be brought about by the disease itself. Seeing how the data they gathered compares to recent studies, they noted similar baseline and post-operative CMT in diabetic eyes who undergo phacoemulsification when they compared their results with those gathered by the Pan American Collaborative Retina Study Group (PACORES), but these findings were different from that reported by Fernandez-Blanco et al. as they showed in a prospective study of 260 consecutive phaco surgeries operated from September 2004 to March 2005, a low incidence of clinical CME. OCT showed increased macular thickness in both group of patients (non-diabetic and diabetics) in a small percentage of cases and significantly increased macular thickness in diabetic patients.

This study demonstrated that 20% of diabetic patients developed increases in MT after cataract surgery. Its peak incidence was at 3, 6 months post-surgery, the main drawback of this study was the small number of patients included might have affect results. So, further studies with large number of patients may be needed regarding this point in the future.

Conclusion:

Our results suggest that Diabetes influences the central macular thickness in diabetic patients, who are more liable to changes in central macular thickness after cataract surgery even if uncomplicated

OCT is valuable, non invasive, reproducible device to detect Pre&Post operative changes in macular thickness and it represents the single most important diagnostic and prognostic tool in management of macular oedema.

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