
DISCUSSION

Diabetic macular edema is a leading cause of visual loss in industrialized countries.⁽¹²³⁾ Significant number of diabetic people with proliferative retinopathy are considered at risk of vision loss if they do not get suitable medical care.⁽¹²⁴⁾

For decades, corticosteroids have been used in Ophthalmology to suppress intraocular inflammation and reduce extravasations from leaking blood vessels. In an attempt to avoid the systemic adverse effects of steroids and high concentrations of cortisone at the site of action, Graham and Peyman (1974).⁽¹²⁵⁾ as well as Machemer (1979)⁽¹²⁶⁾ studied the possibility of injecting cortisone directly into the vitreous cavity in experimental settings in animals and in selected clinical situations in patients. They found that crystalline cortisone may not have a toxic effect on intraocular tissue.

Previous studies revealed that a single intraocular injection of triamcinolone may be an adjunctive treatment for exudative age-related macular degeneration, neovascular glaucoma⁽¹²⁷⁾, proliferative diabetic retinopathy, uveitic cystoid macular oedema, severe uveitis, prephthical ocular hypotony and diabetic macular oedema.^(128,129)

OCT added a high-resolution cross sectional scanning of the entire macular area. OCT can be fundamental in the diagnosis and follow up of DME as it could not give only an objective measurement of the macular thickness with a resolution of 10 microns but also an image of intraretinal structure like photoreceptors layer and epiretinal tractions.⁽⁹²⁾

Spectral (Fourier) domain technology has allowed for the development of a new generation of commercial OCT instruments with higher axial resolution ($\approx 5\mu\text{m}$) compared to time domain instruments ($\approx 10\mu\text{m}$). One such instrument that is currently available is the CirrusTM HD-OCT (Carl Zeiss Meditec, Inc., Dublin, CA). Several reports have recently described morphological characteristics of the photoreceptor layer in various macular diseases using CirrusTM HD-OCT by developing a prototype software algorithm that allows us to quantify the photoreceptor outer segment (PROS) length by measuring the distance between the IS/OS junction and the RPE.⁽⁸⁶⁻⁸⁹⁾

The aim of this study was to correlate between the changes in PROS length and visual acuity in patients with DME after intravitreal triamcinolone acetonide injection.

Retinal changes after IVTA injection

Changes in retinal thickness

One month after IVTA injection, the retinal thickness, in central subfield zone, was decreased significantly. During the follow up of cases after six months, we observed some regression in retinal thickness but it remained below the preoperative values.

The study results are nearly similar to the results of Massin, et al study⁽¹³⁰⁾, who evaluated the efficacy and safety of one intravitreal injection of triamcinolone acetonide for diabetic macular edema in prospective controlled study including 12 eyes, the study stated that the mean central macular thickening was $509.6\pm 143.5\ \mu\text{m}$ before injection and

decreased to $207.3 \pm 44.2 \mu\text{m}$ and $207 \pm 96.7 \mu\text{m}$ one and three month after injection, while the thickness increased again to reach $426 \pm 182 \mu\text{m}$ in 7 of the 12 eyes.

Similar in Karacorlu, et al study,⁽¹³¹⁾ the study included 12 eyes of 12 diabetic patients in which intravitreal injection of 0.1 (4 mg) of triamcinolone acetonide was afforded to treat macular oedema as a primary treatment. The base line of mean central macular thickness was 448.6 μm . At one month follow up a reduction of mean central macular thickness of 40.8% to reach 265.4 μm . At three & six months, mean central macular thickness was 310 & 294.5 respectively.

Changes in retinal PROS length

In this study, we evaluated the changes in PROS length in macular grid, central subfield and central foveal point areas after IVTA injection during one month and six month follow up visits. The results revealed significant decreasing in PROS length in the all three areas in both follow up visits. But unfortunately there was no previous studies evaluating these changes.

Visual acuity and retinal changes after IVTA injection

In the present study, there was a statistically significant increase in the visual acuity at the follow up visits, at the one month follow up visit, VA range showed an improvement 6/60 (0.1) – 6/9 (0.63) ($p < 0.001$), at the 6 months follow up visit, VA range of 40% of cases decreased to reach 5/60 (0.08) – 6/9 (0.63) ($p < 0.001$), but still showed statistically significant improvement ($p \leq 0.05$).

In the study of Jonas and coworkers, they reported the results of a prospective and non-randomized study on 166 eyes with diffuse DME. IVTA was done in 97 eyes. Visual acuity increased by at least two lines in 68% of the treated eyes compared with 33% in the eyes of the control group.⁽¹³²⁾

In another study of Khalid Mahmood et al,⁽¹³³⁾ which was done to evaluate The visual outcome in patients with refractory diabetic macular edema receiving intravitreal triamcinolone acetonide injection. Pre operatively there was 1 (2%) eye with VA $> 6/18$, 28 (56%) eyes with VA 6/24-6/60 and 21 (42%) eyes had VA $< 6/60$. one month post operative follow up visit there were 6 (12%) eyes with VA $> 6/18$, 31 (62%) eyes with VA 6/24-6/60 and 13 (26%) eyes had VA $< 6/60$.

Again in Karacorlu, et al study,⁽¹³¹⁾ As regarding BCVA no eyes lost vision all over the study, 10 eyes (83.2%) showed improvement at 1st month, at 3rd month 8 eyes (66.6%) showed improvement while at the 6th month ten eyes (83.2%) maintained improved visual acuity. In the current study regarding BCVA no eyes lost vision all over the study.

Finally, we correlated between the changes in PROS length and the improvement of visual acuity after IVTA injection. This correlation revealed the more improvement in the visual acuity along with the decreasing in the PROS length after IVTA injection. In addition, we compared this correlation with another one which was done between the

retinal thickness and visual acuity and we found that it was more statistically significant in the first correlation.

In the study of Farzin Forooghian et al,⁽¹³⁴⁾ which was the first report demonstrating the use of an OCT-based approach for the quantification of PROS length in patients with DME and to describe the correlation between PROS length and visual acuity. They observed that the correlation between PROS length and visual acuity was comparable to greater than that previously reported between macular thickness and visual acuity. The modest correlation between retinal thickness and visual acuity that has been previously reported. We found PROS length measurements correlated more strongly with visual acuity than macular thickness measurement, suggesting that PROS length may represent a novel and reliable correlate of visual acuity in patients with DME.

The results of this study demonstrate the retinal changes in diabetic patients after IVTA injection and how there is stronger correlation between changes in the PROS length and the progression of visual acuity after injection.

The limits of present study were that we did not have a larger sample of patients with longer follow up period.

Thorough further studies and new investigative tools that could add accurate data about the changes in photo receptor in diabetic patients which allow better follow up and new lines of management.

SUMMARY

Diabetic macular edema is a common cause of visual loss in eyes with diabetic retinopathy. The beneficial effect of intravitreal triamcinolone injection in improving the visual acuity and retinal thickness in eyes with diabetic macular edema has been proved by many studies.

OCT has been shown to be effective in the qualitative and quantitative description of DME, OCT has demonstrated that macular edema is a complex clinical entity with various morphologies that have to be described in order to choose the correct therapeutic approach.

OCT added a high-resolution cross sectional scanning of the entire macular area. OCT can be fundamental in the diagnosis and follow up of DME, giving not only an objective measurement of the macular thickness with a resolution of 10 microns, but also an image of intraretinal structure and epiretinal tractions, This makes OCT the preferred indicator of therapeutic benefit of different treatment strategies.

The aim of this study was to correlate between the changes in PROS length and visual acuity in patients with DME after intravitreal triamcinolone acetate injection.

This study was carried out on 30 eyes of 22 patients. All of them have diabetic macular edema which defined as thickening of the retina and/or hard exudates within one disc diameter of the center of the macula on biomicroscopy, and all the cases received intravitreal injection of triamcinolone acetate and evaluated one and six months after intravitreal triamcinolone injection.

Patients were excluded in the current study if they had an ocular condition (other than diabetes) that might produce macular edema or alter visual acuity during the course of the study (e.g glaucoma, high myopia, other retinal vascular diseases, previous ocular surgery and anterior segment opacity).

Patients were subjected to detailed ophthalmic evaluation including best corrected visual acuity, anterior segment examination, intraocular pressure measurement, fundus examination with slit lamp biomicroscopy, fluorescein angiography and macular thickness evaluation by OCT.

Several parameters were extracted and statistically analyzed :

- Retina thickness in central subfield zone.
- Photoreceptor outer segment length in:
 - Macular grid area.
 - Central subfield zone.
 - Central foveal point.

First of all, there was statistically significant decrease in macular thickness one and six months after IVTA. As after one month it was observed to be decreased and after 6 months revealed increasing but still lower than that measured before IVTA injection. Previous studies confirmed the same results which refers to the efficacy of IVTA injection

on the DME. Secondly, PROS length was evaluated in macular grid, central subfield and central foveal point areas after IVTA injection during one month and six month follow up visits. The results revealed significant decreasing in PROS length in the all three areas in both follow up visits.

This study confirmed the efficacy of IVTA as most of cases gained at least one visual line and few eyes lost one visual line due to regression in photoreceptor length or got complication like cataract after IVTA injection.

Finally, the changes in PROS length was correlated with the improvement of visual acuity after IVTA injection which revealed more improvement in the visual acuity along with the decreasing in the PROS length after IVTA injection and it was more statistically significant than the correlation between the retinal thickness and visual acuity suggesting that PROS length may represent a novel and reliable correlate of visual acuity in patients with DME.

CONCLUSIONS

- OCT offers an objective, sensitive, non-invasive and quantitative tool for the assessment of macular thickening and other retinal layers like photoreceptor layer.
- Intravitreal Triamcinolone acetonide injection seems to be an effective treatment for diffuse diabetic macular oedema, associated with reduction in retinal macular thickness and photoreceptor outer segment layer length which lead to an improvement in the visual acuity.
- The assessment of changes in the photoreceptor outer segment layer length is considered a reliable and a novel way to follow the improvement of the visual acuity after IVTA injection in DME.