ORIGINAL ARTICLE

STUDY OF CHANGE IN MACULAR VOLUME WITH UNCONTROLLED HBA1C LEVELS IN A DIABETIC PATIENT IN ABSENCE OF DIABETIC MACULAR OEDEMA

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ABSTRACT

Background: This study is aimed to find out the correlation between change in macular volume on optical coherence tomography (OCT) in patients with uncontrolled HbA1c levels .

Methods: It is a observational study. Patients with diabetes mellitus for over 5 years were included in the study. Only one eye of each patient was selected for analysis. Eyes with proliferative diabetic retinopathy were not included in the study. Chronic HBA1c level was defined as mean HbA1c value in last one year duration. Central Subfield Volume (CSV) , Central Subfield Thickness (CST) and Total Macular Volume (TMV) were all measured by OCT.

Results: 50 eyes from 50 patients (22 women and 28 men ; mean age 63.5 years). Mean duration of Diabetes Mellitus (DM) being 10.5 years. 6 patients had Type 1 DM and 44 patients had Type 2 DM. Of these , 19 eyes (38 %) had no diabetic retinopathy (DR) and 31 eyes (62 %) had non proliferative diabetic retinopathy. In statistical analysis , CST (mean 188.82 ± 27.62 μm , p = 0.03) , CSV (mean 0.148 ± 0.022 mm^3 , p = 0.03) and TMV (mean 6.495 ± 0.717 mm^3 , p = 0.003), all positively correlated with chronic HBA1c level (8.95 ± 1.40 %).

Conclusion: There is a positive correlation between chronic HbA1c and macular volume in patients with DM > 5 years duration without Macular oedema. Our studies suggest that there are changes in values of subclinical macular volume or thickness before onset of diabetic macular oedema (DMO) becomes clinically significant. Strict glycaemic control (HbA1c levels below 6) is needed in case of diabetic patients to prevent development and further deterioration of macular function prior to development of DMO .

Key words: Macular thickness, macular volume, HbA1c, non proliferative diabetic retinopathy, diabetic macular oedema – optical coherence tomography

INTRODUCTION

Diabetic Macular oedema is defined as retinal thickening within 2 disc diameters of the centre of the macula , causing leakage of plasma constituents into the surrounding retina due to microvascular changes in the blood retinal barrier and ultimately leading to retinal oedema.[1] It is one of the commonest cause of visual loss in DM. Diabetic macular edema is classified in focal and diffuse types and this is important because the treatments of the two types are different. Focal edema is caused by leakage from micro aneurysms and is associated with hard exudates rings. Diffuse edema is caused by leakage from retinal capillaries and arterioles. Two types of laser treatment for DMO are focal and grid. Focal laser treatment is used to treat focal diabetic macular edema; the purpose is to close the leaking micro aneurysms. Grid laser is used to treat diffuse macular edema and is applied in areas of retinal thickening with diffuse leakage.[1] The Early Treatment Diabetic Retinopathy Study (ETDRS) Research group (1985) demonstrated the focal laser photocoagulation reduces moderate vision loss by 50 % or more in DMO.

The Wisconsin Epidemiology Study of Diabetic Retinopathy (WESDR) in 1995 showed that there is an increase in diabetic macular edema in patients with increase HbA1c.[2] Two other randomized trials conducted revealed that good control and reduction in HbA1c levels lead to a decrease in rates and development and progression of Diabetic macular edema as well as diabetic retinopathy.[3,4,5] The drawback of these earlier studies were that they were unable to detect mild changes in macular edema. A newer modality, OCT enables us to study the structures of

the macula properly and detect even minimal changes in thickness. Some recent studies have shown that there is retinal thickness before development of macular edema.[6] Another recent study states that as the probability of macular thickening increases on OCT examination there is probability of increase in severity of diabetic retinopathy.

The purpose of this study is to find out the correlation between change in macular volume on optical coherence tomography (OCT) in patients with uncontrolled HbA1c levels.

METHODOLOGY

It is a observational study conducted in 50 patients attending the ophthalmology OPD between Jan15-July 15. Written informed consent was taken from all patients. Ethics Committee Clearance was obtained before starting the study.

Inclusion criteria: Patient who had diabetes since >5 years without macular edema with or without NPDR were include in the study.

Exclusion criteria: Patient having **e**yes with proliferative diabetic retinopathy (PDR); Eyes with cystoids serous maculae edema (CSME); and Other modalities like epiretinal membrane (ERM), age-related macular edema (ARMD), prior laser IV Bevacizumab, Triamcinolone were excluded from the study.

One eye of each patient was selected. If both eyes had increase macular thickness the eye with thinner macula was selected. A complete ocular examination was done which included VA using Snellens, intraocular pressure (IOP) measurement with non contact tonometer; dilated fundus examination with direct ophthalmoscopy and indirect ophthalmoscopy, OCT was used to evaluate macular thickness and volume. RT (Retinal thickness), CST (Central Subfield Thickness), CSV (Central Subfield Volume), TMV (Total Macular Volume) were recorded for each patient. CST and CSV are the mean thickness and volume in a region <0.05 mm from the fovea respectively. TMV is the total volume within a radius of 3mm from the fovea. Single sample of HbA1c was taken to check glycaemic control over last 3 months.

Statistical analysis- Pearson's correlation coefficient was used to find out the relationships between age, duration of diabetes, HbA1c level, CST, CSV and TMV. P value <0.05 was considered statistically significant. All patients were divided into 2 groups with no diabetic retinopathy and those with NPDR.

RESULTS

50 eyes from 50 patients (22 women and 28 men; mean age 63.5 years) were selected. Mean duration of DM being 10.5 years. 6 patients had type 1 DM and 44 patients had type 2 DM. Of these, 19 eyes (38%) had no DR and 31 eyes (62%) had NPDR. In statistical analysis, CST (mean 188.82 +/-27.62um, p=0.03) CSV (mean 0.148 +/- 0.022 mm^3,p=0.03) and TMV (mean 6.495 +/- 0.717mm^3, p=0.003) , all positively correlated with chronic HbA1c level (9.95 +/- 1.40%).

Table 1: Comparisons between patients with and without diabetic retinopathy

Variable	No DR	NPDR	P value
Age(years)	61.5+/-14.7	61.75+/-12.5	0.753
Diabetic duration(years)	12.3+/-5.9	13.7+/-4.2	0.335
HbA1c value	9.1	10.6	0.002
CST	180.4+/-26.2	192.6+/-26.2	0.012
CSV	0.146+/-0.166	0.156+/-0.100	0.030
TMV	6.356+/-0.612	6.616+/-0.761	0.046

Table 1 shows that patients who had more uncontrolled HbA1c levels showed more macular thickening. However there was no significant difference in age and DM in 2 groups. P value is calculated by independent sample t-test.

DISCUSSION

OCT is the new and precise method to look for macular thickening which was used in our study.[7]

The increase in macular thickening in DM can be explained by 2 mechanisms. Firstly microvascular damage can cause changes in hemodynamic of macula causing thickening of macula due to breakdown of inner blood retinal barrier. Studies have shown that long standing hyperglycemia can cause hydration of macula due to osmosis and also increase in foveal thickening.

Endometrial cell dysfunction due to microvascular damage causes changes in structure of retinal cells and the microvascular damage is more with uncontrolled HbA1c and our results are similar to that.[8,1]

In our study TMV has stronger correlation to uncontrolled HbA1c as compared to CST and CSV. This finding is different from an earlier study which shows that CST is preferred for OCT measurement of central macula. This difference could be due to

DMO which was excluded from the study unlike previous study which has included it. The hemodynamic changes in pre-macular edema stages are diffused disturbances rather than focal changes in fovea. So in our study there is change in TMV instead of CMV.[9]

In our study, there is more significant increase in TMV, CST, CSV in subgroup with NPDR than sub group with no DR. this finding is similar to an earlier study done by Browning.[10,11]

No treatment was given to the patients who participated in our study because patient did not have CSME.

CONCLUSION

In our study we concluded that there is a positive correlation between macular volume and thickness in patients with uncontrolled HbA1c levels. Hence these patients require regular follow up since they are more prone to develop macular edema and hence regular OCT was advised to these patients for early detection and treatment of macular oedema.

REFERENCES

1. Antcliff RJ & Marshall J (1999): The pathogenesis of oedema in diabetic maculopathy. Semin Ophthalmol 14: 223–232.
2. Klein R, Moss SE, Klein BE, et al. The Wisconsin Epidemiologic Study of Diabetic Retinopathy. XI. The incidence of macular edema. Ophthalmology. 1989;96:1501–10.
3. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med. 1993; 329:977–986.
4. UK Prospective Diabetes Study (UKPDS) Group. UK prospective diabetes study VIII. study design, progress and performance. Diabetologia. 1991;34:877–890.
5. Higgins GT, Khan J & Pearce IA (2007): Glycaemic control and control of risk factors in diabetes patients in an ophthalmology clinic: what lessons have we learned from the UKPDS and DCCT studies? Acta Ophthalmol Scand 85: 772–776.
6. Browning DJ, Fraser CM & Clark S (2008a): The relationship of macular thickness to clinically graded diabetic retinopathy severity in eyes without clinically detected diabetic macular oedema. Ophthalmology 115: 533–539.
7. Schaudig UH, Glaefke C, Scholz F & Richard G (2000): Optical coherence tomography for retinal thickness measurement in diabetic patients without clinically significant macular oedema. Ophthalmic Surg Lasers 31: 182–186.
8. Ferris FL III & Patz A (1984): Macular oedema. A complication of diabetic retinopathy. Surv Ophthalmol 28: 452–461.
9. Kayykcyolu O, Ozmen B, Seymenoglu G, Tunali D, Kafesciler SO, Guclu F & Hekimsoy Z (2007): Macular oedema in unregulated type 2 diabetic patients following glycaemic control. Arch Med Res 38: 398–402.
10. Browning DJ, Fraser CM & Clark S (2008a): The relationship of macular thickness to clinically graded diabetic retinopathy severity in eyes without clinically detected diabetic macular oedema. Ophthalmology 115: 533–539.
11. Browning DJ, Glassman AR, Aiello LP et al. & the Diabetic Retinopathy Clinical Research Network (2008b): Optical coherence tomography measurements and analysis methods in optical coherence tomography studies of diabetic macular oedema.Ophthalmology 115:1366–1371.