

A study on the angle of anterior chamber in relation to duration of diabetes mellitus and stages of diabetic retinopathy

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Abstract

Introduction: Persons with diabetes are more prone to develop shallow anterior chamber than the non diabetics. Decrease in Anterior chamber depth may lead to primary angle closure glaucoma (PACG). Our objective is to measure ACD in relation to diabetes duration and the presence of diabetic retinopathy.

Materials and Methods: 250 eyes of 125 patients with type II DM were analyzed in this study. Patients were grouped based upon the duration of DM as less than 5 years, 5 to 10 years and more than 10 years. Gonioscopy with Goldmann 3 mirror goniolens and Goldmann 3 mirror fundus contact lens were used for the measurement of ACD.

Results: Grade 1 ACD was more prevalent in the patients with diabetes duration of more than 10 years (60%) and Grade 4 in the less than 5 years group (47%). Grade 1 was significantly associated with severe NPDR and Grade 4 was associated with patients with out retinopathy (pValue=0.000).

Conclusion: ACD is decreased with a longer duration of diabetes and the presence of diabetic retinopathy. Evaluation of ACD in diabetic patients is highly necessary to predict its serious complication, primary angle closure glaucoma (PACG).

Keywords: Anterior Chamber Depth (ACD), Diabetes Mellitus, Diabetic Retinopathy Primary Angle Closure Glaucoma (PACG), Gonioscopy

Introduction

Diabetes mellitus is a major health problem throughout the world and there has been a significant increase in the prevalence of diabetes over the last few years, particularly in India. WHO has mentioned India as “The diabetic capital of the world” as it has got the highest number of diabetics. Various studies have shown that diabetes has become a pandemic from epidemic.^(1,2,3) It is a highly prevalent group of metabolic diseases associated with long term damage, dysfunction and failure of various organs especially the eyes. So it is important in screening the diabetics and prevents them from serious visual sequela.^(4,5)

It is estimated that Diabetic Retinopathy develops in more than 75% of diabetic patients within 15 to 20 years of diagnosis of diabetes. The overall prevalence of Diabetic Retinopathy in the population is 17.6%.⁽⁶⁾

There is some correlation between the width in angle of anterior chamber and diabetes mellitus which has been recognized in recent times. Any occludable angle can potentially lead to acute angle closure. Measurement of ACD acts as a valuable tool for the prediction and diagnosis of primary angle closure glaucoma (PACG).⁽⁷⁾ Glaucoma is one of the most common causes of blindness and its risk is increased in diabetic patients. Most previous studies have found a positive association between diabetes and open angle glaucoma.^(8,9)

Anterior chamber depth (ACD) decreases on accommodation due to forward movement of lens and altering curvature of anterior capsule of lens.⁽¹⁰⁾ Persons with diabetes have shallower anterior chamber than

those without diabetes.⁽⁵⁾ Shallow anterior chamber can be due to many reasons. One such reason is increase in lens thickness.⁽⁹⁾ In diabetic patients, lens is found to be thick and more convex when compared with normal subjects.^(11,12) Epithelial layer changes in diabetes include accumulation of glycogen granules and occasional focal epithelial cells degeneration results in thickening of cornea in diabetic patients.⁽¹³⁾

As 90- 95% of all diabetic patients have Type- II diabetes or adult onset diabetes,⁽²⁾ this study has been directed towards those patients and is aimed at evaluating the impact of diabetes mellitus on anterior chamber depth in relation to duration of disease and severity of retinopathy.

Materials and Methods

We carried out a cross-sectional study in patients who presented to Sri Manakula Vinayagar Medical College and Hospital, who had type II diabetes mellitus. The study was carried out over a period of 16 months from September 2013 to November 2014.

Inclusion criteria

- Both genders of age more than 40 years old.
- Diagnosed with Type 2 Diabetes Mellitus.

Exclusion criteria

- Patients with ocular inflammations.
- Patients with past history of ocular surgeries.
- Patients with past history of blunt or penetrating ocular trauma.
- Patients in whom the fundus couldn't be visualised.

125 patients fulfilling the above criteria were included in the study. After getting an informed consent

from patients, detailed history regarding name, age, sex, occupation, address, drug history presenting symptom, duration, associated conditions and past history was recorded. History of diabetes such as symptoms, duration, and type of treatment was enquired.

Slit lamp examination of anterior segment, gonioscopy to view the angle of anterior chamber, dilated fundus examination were recorded. Gonioscopy with Goldmann 3 mirror gonioscope under slit lamp and fundus examination with Goldmann 3 mirror fundus contact lens were done. Diabetic retinopathy was Graded as per ETDRS guidelines.

Statistical analysis: Multiple comparisons were conducted between the study groups by applying a post hoc test (Dunnnett's test) following ANOVA with a confidence interval of 95%. P value of <0.001 was considered significant.

Results

250 eyes of 125 patients were analysed in this study. Out of 125 patients, included here 64 were males and 61 were females.

Among the 250 eyes, 5 eyes had Shaffer Grade 1 angle of anterior chamber which accounts to 2%. 45 eyes had Grade 2 accounting for 18 %. Grade 3 was found in 93 eyes implying for 37.20 %. 107 eyes had Grade 4 which accounts for 42.80% (Table 1).

Duration of diabetes: Duration of diabetes has been classified into 3 categories as < 5 years (46.40%), 5-10 years (44%) and > 10 years (9.60%) (Table 2).

When the duration of diabetes was less than 5 years, Grade 4 was found to be 47.6% followed by Grade 3 47.3% when compared to other Grades. When the duration of Diabetes Mellitus is 5-10 years, it was found that the distribution was more under Grade 4 category being 47.6% followed by Grade 3 being 40.8%. Duration of diabetes when it is more than 10 years, it was found as Grade 1 being more in

distribution of 60%. However when compared with the other groups Grade 1 was found to be prone in patients with duration of more than 10 years of diabetes mellitus (Table 3).

Diabetic retinopathy: Among the 250 eyes, 182 were diabetic without retinopathy, 22 were mild retinopathy, 32 were moderate and 14 were severe (Table 4).

Mean angles in normal mild and severe DRs were 33.80, 30.91, 34.38, 25.71 respectively (Table 5).

The association between Grade 1 and Grade 3 angle in severe non-proliferative diabetic retinopathy was found to be statistically significant with a p value of 0.000. Whereas Grade 4 angle is statistically significant in patients with no retinopathy and in moderate non-proliferative diabetic retinopathy (p value of 0.000) (Table 6).

Table 1: Rate of ACD Grades among the study population

ACD Grade	Number/ Percentage of eyes
Grade 1	5(2%)
Grade 2	45(18%)
Grade 3	93(37.20%)
Grade 4	107(42.80%)
Total	250(100%)

Grade 4 was more prevalent among the study population

Table 2: Duration of diabetes among the study population

Duration of Diabetes	No of Patients	Percentage of patients
Less than 5 years	58	46.40%
5- 10 years	55	44%
More than 10 years	12	9.60%

Table 3: Distribution of ACD Grades in relation to duration of diabetes mellitus

Duration of DM (years)	Grade 1	Grade 2	Grade 3	Grade 4
N	5	45	93	107
< 5	1(20%)	20(44.44%)	44(47.3%)	51(47.6%)
<5-10>	1(20%)	20(44.44%)	38(40.8%)	51(47.6%)
>10	3(60%)	5(11.1%)	11(11.8%)	5(4.6%)

Grade 1 is associated with >10 and Grade 4 is prevalent in <5 and <5-10>

Table 4: Rate of DR in the study population

Number of eyes	Normal Fundus	Mild retinopathy	Moderate retinopathy	Severe retinopathy	Total
	182	22	32	14	250

Of the total 250 eyes 68 were DR and 182 were non-DR

Table 5: Distribution of ACD Grades among different types of DR and non DR eyes

	No retinopathy	Mild retinopathy	Moderate retinopathy	Severe retinopathy	Total
Mean Angle (in degrees)	33.80	30.91	34.38	25.71	33.17

Shallow ACD was observed in severe NPDR

Table 6: Association of ACD with DR

(I) (J) DR_Grade DR_Grade	Mean Difference (I-J)	Std. Error	Sig.
Mild NPDR	2.895	1.649	.080
Moderate NPDR	-.571	1.400	.684
Severe NPDR	8.090*	2.062	.000
No DR	-2.895	1.649	.080
Moderate NPDR	-3.466	2.024	.088
Severe NPDR	5.195*	2.499	.039
No DR	.571	1.400	.684
Mild NPDR	3.466	2.024	.088
Severe NPDR	5.195*	2.342	.000
No DR	-0.890*	2.026	.000
Mild NPDR	-5.195*	2.499	.039
Moderate NPDR	-8.661*	2.342	.000

Grade 1 was significantly associated with severe NPDR and no NPDR is associated with Grade 4

Discussion

Our study showed that the patients with type II diabetes mellitus had shallow anterior chamber depth in relation to the duration of the disease and severity of diabetic retinopathy.

Increasing lens thickness and decreasing anterior chamber depth with increasing duration of diabetes have been confirmed in a population based twin study and it was also found that anterior chamber depth was negatively correlated with duration of diabetes.⁽¹⁴⁾ Tai MC, Lin SY et al proved in patients with acute hyperglycemic status did not cause any significant changes in anterior chamber depth, lens thickness.⁽¹⁵⁾

Studies have found that diabetic patients have a shallower anterior chamber, thicker central cornea and lens. In Tanjong Pagar Survey conducted by Seang Mei Saw and associates stated that in Singapore Chinese population with diabetes had shallower anterior chambers and thicker lens than those without diabetes.⁽⁵⁾ In a study which involved 150 canine eyes, the anterior chamber depth was significantly reduced in eyes with diabetic cataracts compared with eyes with non-cataractous lenses but not in other eyes.⁽¹⁶⁾

There is some correlation between the width in angle of anterior chamber and diabetes mellitus which has been recognised in recent times. Any occludable angle can potentially lead to acute angle closure.⁽⁵⁾ Devereux and Foster conducted a cross-sectional study on 1000 Mongolian patient and concluded that the measurement of axial anterior chamber depth detects occludable angles in this Asian population and

therefore they have a major role in population screening for primary angle-closure glaucoma.⁽¹⁷⁾

A two phase, cross sectional, community based study was conducted by Foster, Devereux et al on rural and urban areas of Mongolia where 1717 diabetic subjects were under examination. Occludable angles were identified in 140 subjects, 28 of these had PACG. 15% were under Grade 1 with a sensitivity and specificity of 84% and 86% respectively for the detection of occludable angles, thus proving the significance of occludable angle in diabetic patients.⁽¹⁸⁾

According to Browning and Rotberg as the retinopathy severity progresses the anterior chamber depth becomes shallow. It has been proved that certain treatment for diabetic retinopathy such as Pan retinal Photocoagulation or treatment of its complications like Scleral buckling can lead to forward rotation of ciliary body and secondary narrowing of anterior chamber angle. Silicone oil or pneumatic retinopexy in which gas is used can also push the iris forward and obstruct the aqueous outflow or treatment for its complications like retinal detachments.⁽¹⁹⁾

A negative association of anterior chamber depth with diabetic retinopathy is also seen in the literature Aung.⁽²⁰⁾

In our study we found out that Grade 1 was statistically significant in Severe NPDR (Non Proliferative Diabetic Retinopathy) group when compared with other groups, whereas Grade 4 angle was statistically significant in no retinopathy group.

This suggests that gonioscopy can be used as a screening tool in all patients with a longer duration of diabetes mellitus to rule out angle closure thus preventing its complication further.

Conclusion

Studies have shown that diabetic patients have shallower anterior chamber and thicker lens. Diabetic patients have shallower anterior chambers are prone to angle closure glaucoma. This study has found statistically significant association in the anterior chamber depth of diabetic patients with respect to duration of diabetes mellitus.

There was also a significant difference in anterior chamber depth in patients with diabetes mellitus as the severity of retinopathy progresses.

Since shallower anterior chamber can be a predisposing factor for developing angle closure glaucoma, ACD analysis can be used as a screening tool for diabetic patients particularly in those with a longer duration of disease and as severity of retinopathy progresses.

References

- Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res.* 2007 Mar;125(3):217–30.
- Association AD. Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care.* 2008 Jan 1;31(Supplement 1):S55–60.
- Association AD. Standards of Medical Care in Diabetes—2010. *Diabetes Care.* 2010 Jan 1;33(Supplement 1):S11–61.
- Jeganathan VSE, Wang JJ, Wong TY. Ocular Associations of Diabetes Other Than Diabetic Retinopathy. *Diabetes Care.* 2008 Sep;31(9):1905–12.
- Saw S-M, Wong TY, Ting S, Foong AWP, Foster PJ. The relationship between anterior chamber depth and the presence of diabetes in the Tanjong Pagar Survey. *Am J Ophthalmol.* 2007 Aug;144(2):325–6.
- Williams R, Airey M, Baxter H, Forrester J, Kennedy-Martin T, Girach A. Epidemiology of diabetic retinopathy and macular oedema: a systematic review. *Eye (Lond).* 2004 Oct;18(10):963–83.
- Razeghinejad MR, Banifatemi M. Ocular Biometry in Angle Closure. *J Ophthalmic Vis Res.* 2013 Jan;8(1):17–24.
- Mitchell P, Smith W, Chey T, Healey PR. Open-angle glaucoma and diabetes: the Blue Mountains eye study, Australia. *Ophthalmology.* 1997 Apr;104(4):712–8.
- Tomlinson A, Leighton DA. Ocular dimensions in the heredity of angle-closure glaucoma. *Br J Ophthalmol.* 1973 Jul 1;57(7):475–86.
- Bron AJ, Tripathi BJ. *Wolff Anatomy of eye and orbit.* 8th ed. 1997; 222–278.
- Bron AJ, Sparrow J, Brown NA, Harding JJ, Blakytyn R. The lens in diabetes. *Eye (Lond).* 1993;7 (Pt 2):260–75.
- Wiemer NGM, Dubbelman M, Kostense PJ, Ringens PJ, Polak BCP. The influence of diabetes mellitus type 1 and 2 on the thickness, shape, and equivalent refractive index of the human crystalline lens. *Ophthalmology.* 2008 Oct;115(10):1679–86.
- Busted N, Olsen T, Schmitz O. Clinical observations on the corneal thickness and the corneal endothelium in diabetes mellitus. *Br J Ophthalmol.* 1981 Oct;65(10):687–90.
- Løgstrup N, Sjølie AK, Kyvik KO, Green A. Long-term influence of insulin dependent diabetes mellitus on refraction and its components: a population based twin study. *Br J Ophthalmol.* 1997 May;81(5):343–9.
- Tai M-C, Lin S-Y, Chen J-T, Liang C-M, Chou P-I, Lu D-W. Sweet hyperopia: refractive changes in acute hyperglycemia. *Eur J Ophthalmol.* 2006 Oct;16(5):663–6.
- Williams DL. Lens morphometry determined by B-mode ultrasonography of the normal and cataractous canine lens. *Vet Ophthalmol.* 2004 Apr;7(2):91–5.
- Devereux JG, Foster PJ, Baasanhu J, Uranchimeg D, Lee PS, Erdenbeleg T, et al. Anterior chamber depth measurement as a screening tool for primary angle-closure glaucoma in an East Asian population. *Arch Ophthalmol.* 2000 Feb;118(2):257–63.
- Foster P, Devereux J, Alsbirk PH, Lee PS, Uranchimeg D, Machin D, et al. Detection of gonioscopically occludable angles and primary angle closure glaucoma by estimation of limbal chamber depth in Asians: modified grading scheme. *Br J Ophthalmol.* 2000 Feb;84(2):186–92.
- Rotberg MH, Browning DJ. Diabetic Retinopathy. *Charlotte eye ear nose and Throat associates.* 1995;56(13):325–6.
- Aung T, Nolan WP, Machin D, Seah SKL, Baasanhu J, Khaw PT, et al. Anterior chamber depth and the risk of primary angle closure in 2 East Asian populations. *Arch Ophthalmol.* 2005 Apr;123(4):527–32.