Original Research Article

A Study to Evaluate the Intraocular Pressure Variations in Type 2 Diabetes Mellitus

Seema Channabasappa[1], Sanjana S[2], M S Mirdehghan[3]

[1]Professor of Ophthalmology, Vydehi Institute of Medical Sciences and Research Centre, Bangalore, India.
[2]Clinical fellowship in cataract and refractive surgery, Nethradhama Super Speciality Eye Hospital, Bangalore, India.
[3]Senior resident of Ophthalmology, Vydehi Institute of Medical Sciences and Research Centre, Bangalore, India.

Corresponding Author: Seema Channabasappa

ABSTRACT

Aim of the study was to evaluate the intraocular pressure variations in type 2 diabetes mellitus.
Objectives of the study was
1. To establish if there is an increase of intraocular pressure in type 2 diabetes mellitus.
2. To evaluate if the increase in intraocular pressure has any relation to the glycosylated hemoglobin levels.
3. To study the types of primary glaucoma and establish the most common type of glaucoma seen in the study group.

The findings of this study are as follows:
The mean IOP in the study group was found to be 14.54±3.69 mmHg.2.5% of patients had IOP <10 mmHg, 88.5% had IOP between 10 and 20 mmHg and 9% had IOP >20mmHg

In our study group, patients diagnosed to have POAG, the mean HbA_1c was 6.92±1.40 %, indicating good-fair glycemic control.

The patients diagnosed to have OHT, mean HbA_1c was 6.67±0.31%, indicating good glycemic control. The patients diagnosed to have NTG, the mean HbA_1c was 6.65±0.35 %.The present study showed prevalence of POAG of 6.0%, OHT 3.0% and NTG 2.0%

Conclusion: Diabetics are more prone for developing raised IOP. POAG being the most common type in the study group which constituted 6 % there by showing a strong association between POAG and diabetes. The strength of the association between diabetes and glaucoma did not vary by the degree of glycemic control. The regular screening for glaucoma in type 2 diabetic patients is strongly recommended.

Keywords: Type 2 diabetes mellitus, intraocular pressure, Glycosylated hemoglobin, Primary open angle glaucoma, Ocular hypertension, and Normal tension glaucoma.

INTRODUCTION

Glaucoma is considered as an altered physiological state in the optic nerve head that interacts with the level of IOP, which determines the degree and the rate of the damage. [1] The average normal IOP is about 15mmHg, with a range from 10 to 21mmHg. The IOP is determined by the balance between the production of the aqueous humour and the drainage of the aqueous humour, mainly through the trabecular meshwork which is located in the anterior chamber angle. An abnormally high IOP indicates that either the eye is producing excess fluid, or there is blockage in drainage.

Diabetes has emerged as a major cause of vision loss and visual disability, not only in the developed countries, but also in the developing countries. Diabetes, besides its other ocular manifestations like cataract, retinopathy also affects the IOP. [2]

Numerous large population based studies have shown diabetes to be a risk factor for the development of open angle glaucoma. [3-7] However, some studies have found no association between the same. [8-10] Therefore, this study is being conducted to observe the IOP variations in patients with type 2 diabetes mellitus and also to assess the effects of chronic hyperglycemia on the IOP.

METHODOLOGY

The present study is a cross-sectional observational study among diagnosed cases of type2 diabetes. This study was conducted from December 2012 January 2014, in which the aim was to take at a hundred cases as the sample size. Cases of type 2 diabetes of age above 40 years of both genders who attended the outpatient departments or admitted inpatients in the Departments of Ophthalmology and General Medicine were considered for the study.

A pre-structured proforma was used to collect the baseline data and an informed written consent was obtained after explaining about the need of the study and the procedures that were to be performed for the collection of data. Detailed history was asked and examination performed as per the proforma for those who satisfied the inclusion and exclusion criteria.

Inclusion criteria
- Patients aged above 40 yrs.
- Type 2 diabetes mellitus of more than 6 months duration.

Exclusion criteria
- Established cases of glaucoma on treatment.
- Family history of glaucoma.
- Patients on steroids: Topical/oral/ inhalational.
- Congenital abnormalities of the disc.
- History of ocular trauma/surgeries.
- Hypertensives.
- Type 1 diabetic patient.
- Secondary glaucoma.
- Advanced lens opacity obscuring fundus details.
- Patients with diabetic maculopathy.
- Pathological myopia.
- Patients having uveitis, trauma, pigment dispersion syndrome, pseudo exfoliation syndrome.

RESULTS

Table1: Age, gender, IOP, Duration DM, FBS, PPBS, HbA1c, and CCT with POAG, OHT and NTG

Variables	Complications			p value
	POAG (n=6)	OHT (n=3)	NTG (n=2)	
Age in years	54.83±14.28	47.33±12.70	40.00±2.82	0.388
Male	4(66.7%)	2(66.7%)	0	0.416
Female	2(33,3%)	1(33.3%)	2(100.0%)	
IOP (mmHg)	23.67±1.50	22.67±1.15	16.00±2.83	0.001**
Duration of DM	4.75±1.25	2.00±1.00	2.75±3.18	0.085+
FBS	135.00±27.59	117.00±16.52	169.00±80.62	0.349
PPBS	186.33±20.95	186.33±99.57	271.00±193.74	0.487
HbA$_1$c	6.92±1.40	6.67±0.31	6.65±0.35	0.932
CCT	537.50±15.41	535.67±48.23	529.50±14.89	0.939

The mean age among patients with POAG was 54.83 ±14.28 years, among OHT was 47.33 ±12.70 years and among NTG was 40.00 ±2.82 years.

Out of 6 patients with POAG, 4 (66.7%) were males and 2 (33.3%) were females Out of 3 patients with OHT, 2 (66.7%) were males and 1 (33.3%) was a female. Both the patients of NTG were females.

The mean IOP among patients with POAG was23.67±1.50 mmHg, among OHT was22.67±1.15 mmHg and among NTG was 16.00±2.83mmHg. The difference

observed in mean IOP values among the group was statistically significant ($p<0.05$). The mean value of HbA$_1$c among POAG was 6.92±1.40%, among OHT was 6.67±0.31% and among NTG was 6.65±0.35%.

Correlation between HbA$_1$c and IOP showed Pearson correlation of -0.036 and p value of 0.724 which shows no statistical significance.

Correlation between HbA$_1$c and CCT showed Pearson correlation of 0.084 and p value of 0.240 which again showed no statistical significance.

Statistical methods

a) Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance.

   Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups Inter group analysis) on metric parameters. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

b) **Pearson product moment correlation coefficient**

   Pearson product moment correlation coefficient, denoted by r, has been used in this study as a measure of the correlation between two variables x and y giving a value between plus 1 and -1 inclusive.

Correlation coefficient value

Correlation	Negative	Positive
None	-0.09 to 0.0	0.0 to 0.09
Small	-0.3 to -0.1	0.1 to 0.3
Medium	-0.5 to -0.3	0.3 to 0.5
Strong	-1.0 to -0.5	0.5 to 1.0

c. Significant figures, +Suggestive significance (p value: $0.05<p<0.10$), *Moderately significant (p value: $0.01< p\leq0.05$), **Strongly significant (p value: $p\leq0.01$)

Statistical software used: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, Med Calc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data.

DISCUSSION

A few studies have shown that, of the much comorbidity diabetes is mostly associated with glaucoma.

The Beaver Dam Eye Study by Klein BE et al states that incidence of open angle glaucoma is more among diabetics. [3] The Blue Mountain Eye Study by Mitchell Pet al. also concluded that there is a significant and consistent association between diabetes and glaucoma. [7]

Los Angles Latino Eye study (LALES) showed the prevalence of open angle glaucoma to be 40% higher in participants with type 2 diabetes than in those without type 2 diabetes. [11]

The findings of this study are as follows:

The mean IOP in the study group was found to be 14.54±3.69 mmHg.2.5% of patients had IOP <10 mmHg, 88.5% had IOP between 10 and 20 mmHg and 9% had IOP >20mmHg.

In our study group, 6 patients had IOP > 21mmHg with C/D ratio > 0.6 with glaucomatous field changes. They were diagnosed to have POAG.

POAG group of patients showed a mean age of 54.83±14.28 years.

Out of the 6 patients, 4(66.7%) were males and 2(33.3%) were females. The mean IOP was found to be 23.67±1.50 mmHg.

The mean CCT was 537.50±15.41 microns.

Their mean duration of diabetes was 4.75±1.25 years.

The mean FBS and PPBS values were 135.00±27.59 mg/dl and 186.33±20.95 mg/dl respectively, indicating poor control of diabetes (according to the American Diabetes Association Criteria).

The mean HbA$_1$c was 6.92±1.40 %, indicating good-fair glycemic control. None of the patients had diabetic retinopathy.

Out of the 9 patients with raised IOP, 3 patients (3.0%) had IOP > 21mmHg,

without glaucomatous disc changes and without field changes. They were diagnosed to have OHT. OHT group of patients showed a mean age of 47.33 ± 12 years.

Out of the 3 patients, 2(66.7%) were males and 1(33.3%) was female.

The mean IOP was found to be 22.67 ± 1.15mmHg.The mean CCT was 535.67 ± 48.23 microns.

Their mean duration of diabetes was 2.00 ± 1.00 years.

The mean FBS and PPBS values were 117.00 ± 16.52mg/dl and 186.33 ± 99.57 mg/dl respectively.

The mean HbA_1c was $6.67\pm0.31\%$, indicating good glycemic control. None of the patients had diabetic retinopathy.

2 patients (2.0%) had IOP < 21mmHg with C/D ratio> 0.6 and glaucomatous field changes. they were diagnosed to have NTG.

NTG group of patients showed a mean age of 40.00 ± 2.82 years both the patients (100.0%) were females. The mean IOP was found to be 16.00 ± 2.83mm Hg.

The mean CCT was 529.50 ± 14.89 microns.

Their mean duration of diabetes was 2.75 ± 3.18 years.

The mean FBS and PPBS values were 169.00 ± 80.62 mg/dl and 271.00 ± 193.74mg/dl respectively indicating poor glycemic control.
The mean HbA_1c was 6.65 ± 0.35 %.

In an epidemiological study conducted on the diabetic population in the island of Falster, Denmark by Nielsen NV, it was found that prevalence rate of POAG and OHT was 6.0% and 3.0%, respectively. [12]

The present study showed prevalence of POAG of 6.0%, OHT 3.0% and NTG 2.0%.

IOP Variation According To Age

In the present study, patients $\leq$ 50 yrs, 1.9% had IOP < 10mm Hg, 90.4% had IOP 10-20 mmHg and 7.7% had IOP >20 mmHg. Among the patients aged 51-60 yrs, 93.3% had IOP 10-20 mmHg and 6.7% had IOP >20 mmHg. Among the patients > 60

yrs, 5.6% had IOP < 10mmHg, 77.8% had IOP 10-20 mmHg and 17.7% had IOP > 20 mmHg. It showed p value of 0.409.

Out of the 9 patients with IOP > 20 mmHg, 16.7% of them were above the age group of 60 yrs, 7.7% were between 41-50years and 6.6% were between 51-60years. This shows that IOP increases as the age advances.

Correlation between Glycosylated Hemoglobin and IOP

Few studies show positive correlation between poor glycemic control and raised IOP, while few studies fail to prove the same.

In the study of intraocular pressure in Japanese diabetic patients by Matsuoka Met.al showed that higher glycosylated hemoglobin levels were associated with increased IOP. [13]

A population based case control study conducted in Denmark by Lotte G Welinder et.al showed no correlation between glycosylated hemoglobin levels and glaucoma. [14]

In the present study, among the 100 diabetics, 10(10.0%) patients had normal HbA1c $\leq$5.9%, 65(65.0%) had good glycemic control with HbA_1c 6-7%, 15(15.0%) had fair control with 7.1-8% and 10 (10.0%) had poor control with HbA_1c > 8%.

It had a mean $\pm$SD of $7.01\pm1.66\%$, thus showing no statistically significant correlation between the glycosylated Hb levels and increased IOP according to our study.

SUMMARY

Type 2 Diabetes mellitus is a chronic and progressive disease with ocular and extra ocular manifestations, whose incidence is expected to increase in the coming decade. Glaucoma is the second most common cause of blindness worldwide, if undetected or untreated, can lead to blinding optic neuropathy. Diabetes is an important risk factor for the development of glaucoma. This study took into consideration a hundred diagnosed

cases of type 2 diabetes over a stipulated time period of 1.5yrs. It included patients of both sexes above the age of 40 years and type 2 diabetes mellitus of more than 6 months duration and excluded patients with established cases of glaucoma on treatment, Family history of glaucoma, Patients on steroids: Topical/ oral/ inhalational, Congenital abnormalities of the disc, History of Ocular Trauma/Surgeries, Hypertensives, Type 1 diabetic patients, Secondary glaucoma, Advanced lens opacity obscuring fundus details, Patients with diabetic maculopathy, Pathological Myopia, Patients having uveitis, trauma, pigment dispersion syndrome, pseudo exfoliation syndrome. Their intraocular pressure was measured by Applanation Tonometry.

It was found in this study that the patients with type 2 diabetes are more prone to develop raised IOP. POAG was the commonest in the study group. No correlation was found between glycosylated haemoglobin levels and raised IOP. Because the glaucoma symptoms usually don't surface until the disease has progressed, understanding the risks associated with elevated intraocular pressure, will help us identify which patients would benefit most from screening and monitoring. Thus the emphasis is on regular screening of diabetics for early detection of glaucoma and timely treatment, to prevent sight threatening complications.

REFERENCES

1. Anderson DR. Normal-tension glaucoma (Low-tension glaucoma). Indian J Ophthalmol 2011; 59:97-101.
2. Arora VK, Prasad VN. Intraocular pressure and diabetes: A correlative study. Indian J Ophthalmol 1989; 37:10-12.
3. Klein BE, Klein R, Linton KL. The intra-ocular pressure in an American community. The Beaver Dam Eye Study. Invest Opthalmol Vis Sci.1992; 33:2224-28.
4. Katz J, Sommer A. The risk factors for primary open angle glaucoma. Am J Prev Med. 1988; 4:110 -14.
5. Quigley HA. Open-angle glaucoma. N Engl J Med. 1993; 328:1097-06.
6. Wise LA, Rosenberg L, Radin RG, Mattox C, Yang EB, Palmer JR, et al., A prospective study of diabetes, lifestyle factors, and glaucoma among African-American women. Ann Epidemiol. 2011; 21(6):430-39.
7. Mitchell P, Smith W, Chey T, Healey PR. Open-angle glaucoma and diabetes: the Blue Mountains Eye Study, Australia. Ophthalmology 1997; 104:712-18.
8. Tielsch JM, Katz J, Quigley HA, Javitt JC, Sommer A. Diabetes, intraocular pressure and primary open-angle glaucoma in the Baltimore Eye Survey. Ophthalmology. 1995; 102:48-53.
9. Leske MC, Connell AM, Wu SY, et al. Risk factors for open-angle glaucoma: the Barbados Eye study. Arch Opthalmol 1995; 113: 918-24.
10. Wormald RP, Basauri E, Wright LA, Evans JR. The African Caribbean eye survey: risk factors for glaucoma in a sample of African Caribbean people living in London. Eye 1994; 8:315-20.
11. Chopra V, Varma R, Wu J, Torres M, Azen SP. Type 2 diabetes mellitus and risk of open-angle glaucoma, Los Angles Latino Eye Study. Ophthalmology 2008; 115 (2):227-232
12. Nielsen NV. The prevalence of glaucoma and ocular hypertension in type 1 and 2 diabetes mellitus. An epidemiological study of diabetes mellitus on the island of Falster, Denmark.) Acta Ophthalmol (Copenh). 1983 Aug; 61(4):662-72
13. Matsuoka M, Ogata N, Matsuyama K, Yoshikaw T, Takahashi K. Intraocular pressure in Japanese diabetic patients. Clin Ophthalmol. 2012; 6:1005-1009.
14. Lotte G Welinder, Anders H Riis, Lars L Knudsen, et al. Diabetes, glycemic control and risk of medical glaucoma treatment: A population-based case-control study Original Research. Published Date October 2009 Volume 2009:1 Pages 125 131DOI: http://dx.doi.org/10.2147/CLEP.S683.

****