

ASSOCIATION BETWEEN DIABETES MELLITUS AND GLAUCOMA

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Abstract: *The study's objective was to evaluate the correlation between type 2 diabetes mellitus (T2DM) and primary open-angle glaucoma (POAG). The study was conducted on 180 patients. One hundred ten were included in Group A after being diagnosed with T2DM. Seventy subjects diagnosed with POAG and without T2DM were included in Group B. Examination of the anterior segment, funduscopic evaluation, Optical coherence tomography (OCT) examination, and measurement of Central corneal thickness (CCT) and Intraocular pressure (IOP) were done. The International Society of Geographical and Epidemiological Ophthalmology criteria was used for defining glaucoma. American Diabetes Association criteria were followed for defining diabetes. A total of 180 patients were included in the study. The total participants were further divided into three subgroups (Group A and Group B were major groups): Group I- subjects with T2DM (80, 44.4%), Group II- subjects with glaucoma and T2DM (30, 16.6%), and Group III- subjects with POAG and without T2DM (70, 39%). The study did not confirm the association between glaucoma and T2DM ($P=0.000$). The mean IOP in Group A and B was 15.76 ± 3.09 mm Hg and 18.36 ± 4.38 mm Hg, respectively. The mean CCT in Group A was 539.73 ± 23.7 μ m while in Group B was 532.16 ± 20.8 μ m. Thus, this study could not confirm the association between glaucoma and Type 2 DM.*

Keywords: Open-angle Glaucoma, Diabetes Mellitus Type 2, Intraocular pressure

Introduction

Glaucoma is one of the factors leading to irreversible blindness. Most common type of glaucoma is primary open angle glaucoma (POAG). Its risk factors include family history, old age, myopia, ocular hypertension and central corneal thickness (Zhao and Chen, 2017). Diabetes Mellitus (DM) is increasingly prevalent worldwide because of aging population and lifestyle changes. It leads to severe complications which affect quality of life. A potential risk factor for glaucoma, specifically primary open-angle glaucoma (POAG), is diabetes mellitus. It affects vascular autoregulation of the optic nerve and retina and damages microvasculature. It also increases intraocular pressure (IOP) (Grzybowski et al., 2020, Haddougui et al.). However, association between POAG and DM is controversial (Vergroesen et al., 2022). Different cross-sectional studies have found a positive correlation between POAG and Diabetes (Singh et al., 2022, Rudnicka et al., 2020), while others failed to find a correlation (Kuang et al., 2020, Tang et al., 2020). Different studies have investigated this correlation.

Diabetes has been regarded as a risk factor for POAG as it's pathology of microangiopathy, thus microcirculation of optic disc is compromised which

possibly explains pathogenesis of POAG. Various studies have been conducted globally for finding an association between diabetes and POAG. However, there is scarcity of data for finding significant association between the two in developing states. Thus, our study aims to evaluate the correlation between POAG and T2DM in Pakistani population.

Methodology

The prospective study was conducted in the Department of Ophthalmology, Shahheed Mohtarma Benazir Bhutto Medical University Larkana, from January 2021 to January 2022. The study included patients aged above 40 years. Those with any chronic illness were excluded. The study was conducted on 180 patients. One hundred 110 were included in Group A after being diagnosed with T2DM. Group A participants were evaluated for any signs of POAG presence. Sixty-nine subjects diagnosed with POAG without T2DM were included in Group B. Informed consent of the patients was taken. Detailed examination of the anterior segment, funduscopic evaluation, OCT examination, and measurement of CCT and IOP were done. Van Herrick's method was

used for grading the anterior chamber. IOP for each eye was measured using a Goldmann applanation tonometer (Haag-Streit AG). Three readings were obtained, and the mean was calculated. Central corneal thickness (CCT) for each eye was measured using an ultrasound pachymeter. Five readings were taken, and the mean was calculated. Glaucomatous optic nerve findings were recorded. In glaucoma suspects, automated perimetry was done. International Society of Geographical and Epidemiological Ophthalmology criteria to define glaucoma (Foster et al., 2002). Subjects meeting this definition without primary angle-closure glaucoma, narrow angles, iris neovascularization, or abnormal anterior segment deposits were diagnosed as the subject with POAG. IOP > 21 mm Hg, without glaucoma, was considered ocular hypertension. Glaucoma suspects were categorized based on IOP > 21 mmHg, cup-disc ratio (CDR) > 0.6, presence of closed or occlude angles and peripheral anterior synechiae, signs of pigment dispersion syndrome and pseudo exfoliation syndrome and disc asymmetry with CDR > 0.2. American Diabetes Association criteria were followed for defining diabetes. SPSS version 21 was used for statistical analysis. Standard deviation and mean were calculated. The Chi-square test was used for comparing proportions. P value < 0.05 was considered statistically significant.

Results

A total of 180 patients were included in the study. 91 were male and 89 females. Demographic and clinical data of the participants is summarized in Table I. The total participants were further divided into three groups. Group I- subjects with T2DM (80, 44.4%), Group II- subjects with glaucoma and T2DM (30, 16.6%), and Group III- subjects with POAG and without T2DM (70,39%). The mean T2DM duration was 7.78 ± 7.45% years. The mean glaucoma duration was 4.12±3.4 years. The study did not confirm the association between glaucoma and T2DM. According to fisher’s exact test p value was found to be 0.000, which was not applicable. (Table II). The mean T2DM duration in subjects without glaucoma was 7.76±7.34 years, and with glaucoma was 8.43± 8.2 years. Duration of diabetes did not affect the association with glaucoma (p=0.756). There was a significant association between glaucoma and intake of oral hypoglycemic agents (OHA) (p=0.031). There was no positive association between glaucoma and the use of insulin. Hypertension was found in 90 (50%) subjects. In subjects with T2DM, 59 (75%) had hypertension (p<0.00). Association between systolic and diastolic blood pressure with glaucoma was not statistically significant (p= 0.163 and p=0.335, respectively) (Table III).

IOP and CCT difference between the two eyes were not statistically significant, so the analysis was done using the right eye. In Group A and B, IOP ranged between 17 to 22 mm Hg in most patients (85.3%). The mean IOP in Group A and B was 15.76 ± 3.09 mm Hg and 18.36 ±4.38 mm Hg, respectively. The mean IOP in Groups I, II, and III was 14.17 ±2.53 mmHg, 15.84±3.67, and 17.65±4.57, respectively. Mean IOP with and without glaucoma was 16.78 ±4.42 mm Hg and 14.18± 1.63 mm Hg. IOP was less than 21mm Hg in 78 subjects of Group I, 26 of Group II, and 50 of Group III. The mean CCT in Group A was 539.73±23.7 µm while in Group B was 532.16 ±20.8 µm.

Table I Demographic and clinical data of the patients

	Type II diabetes n=110	Nondiabetics n=70
Age(years)	60.05±11.12	56.08± 12.05
Systolic blood pressure	134.91±16.27	131.39±16.21
Diastolic blood pressure	86.5±9.07	86.51±7.8
Body Mass Index	27.14±5.22	28.41±3.79

Table II Association between POAG AND T2DM

POAG	T2DM		P value
	Yes	No	
Yes	30	70	0.000*
No	80	0	
Total	110	70	

* Not applicable

Table III Association between glaucoma and study parameters

Parameter	P value
Duration of diabetes	0.756
Intake of Oral hypoglycemic agent	0.031
Systolic blood pressure	0.163
Diastolic blood pressure	0.335

Discussion

In the current study, 26.4% of diabetic patients had glaucoma. Different studies have been conducted to evaluate the correlation between POAG and T2DM. A study conducted to find the correlation between

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open-angle glaucoma and T2DM found that in Type 2 diabetics, the prevalence of glaucoma was 40% higher than in non-diabetics (Jung et al., 2018). Another study suggested that there is an increased risk of POAG in diabetics (Kjærsgaard et al., 2022). The current study failed to elicit a correlation between POAG and T2DM, p value according to fisher's exact test was found to be 0.000. It may be because only subjects with POAG and T2DM were included in this study.

Similarly, a study conducted on an unselected sample of diabetic subjects could not confirm the correlation between POAG and diabetes (Tripathi and Srinivasan, 2018). The current study divided subjects into Groups I, II, and III. There was no significant in terms of CCT; however, IOP significantly differed between the three groups. The mean glaucoma duration was 4.12 ± 3.4 years. The association between glaucoma and the duration of diabetes was not significant. Another study had similar results, and longer T2DM duration was not associated with POAG (Gudzenko and Mogilevskyy, 2021). However, a study reported that longer T2DM duration was associated with an increased prevalence of glaucoma ($p < 0.0001$) (Jung et al., 2018). Subjects with a duration of diabetes of more than 15 years were at increased of diabetes. They found out that the presence and duration of diabetes had an independent association with the risk of glaucoma. The mean IOP in Group A and B was 15.76 ± 3.09 mm Hg and 18.36 ± 4.38 mm Hg, respectively. Mean IOP was lower in subjects with T2DM. It may be because in because Group B had subjects diagnosed with POAG. A study showed that in patients with metabolic abnormalities and diabetes IOP is higher as compared to those without these (16.8 vs 14 mm Hg) (Rivera et al., 2020). Diabetes treatment, CCT, smoking, sex, and age were not correlated with glaucoma. Another study found that patients with diabetes have increased CCT, which artificially increases IOP reading (Zhao et al., 2019). A study reported that people with diabetes have significantly higher CCT than non-diabetics (557.3 vs. $549.2 \mu\text{m}$) (Asefa et al., 2019). People with diabetes have thicker CCT than non-diabetics; however, this difference is insignificant. Glaucomatous patients had thinner CCT than non-glaucomatous ($p = 0.018$) (Stuart et al., 2022).

Conclusion

This study could not confirm the association between glaucoma and Type 2 DM. A more extensive prospective study is required to understand this complex relationship.

Conflict of interest

The authors declare no conflict of interest.

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