Original Article

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Association of Glaucoma with Hypertension and Diabetes: A Single-Center Study

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Abstract

Background: Glaucoma is a chronic and progressive optic neuropathy, a common eye disease that causes structural and functional damage to the optic nerve, which connects the eye to the brain. It remains one of the leading causes of irreversible blindness worldwide, including in Bangladesh. Characterized by optic nerve damage and corresponding visual field loss, glaucoma often progresses silently until significant vision has been lost, making early detection critical for effective management. Among the known risk factors, increasing attention has been focused on systemic diseases such as diabetes mellitus and hypertension—both of which are prevalent and growing public health challenges in Bangladesh. Diabetes mellitus, a metabolic disorder with rising incidence in the Bangladeshi population, is associated with various ocular complications. Recent evidence suggests that diabetic individuals may be at higher risk of developing glaucoma, particularly primary open-angle glaucoma (POAG), due to microvascular damage, impaired auto regulation of ocular blood flow, and neurodegenerative changes in the optic nerve. Hypertension, similarly widespread in the country, has also been implicated in the pathophysiology of glaucoma. It is hypothesized that chronic elevated blood pressure may contribute to increased intraocular pressure (IOP) and reduced optic nerve perfusion. **Objectives:** The aim of this study is to assess the association of glaucoma in patients with diabetes and hypertension. **Methods:** This is an observational study. The present study was conducted among 80 diagnosed Glaucoma patients also suffering either for diabetes or hypertension or both attending the ophthalmology outpatient department of BNSB Zahurul Haque Eye Hospital for routine glaucoma follow-up for the duration of the period from January 2022 to December 2023 to assess the association of severity of glaucoma in patients with diabetes and hypertension. Data was entered in MS Excel and Statistical analysis was done using the SPSS-24 version. **Results:** According to the age of 80 Patients aged <20 to ≥50 years. Here according to Age distribution, 9(11.25%) were 20-29, 13(16.25%) were 30-39, 17(21.87%) were 40-49, and 41(50.62%) were ≥50. The total study population was 80 patients, according to gender 42(48.13%) were Male, 38(51.87%) were Female. The Glaucoma patients with diabetes, hypertension and both were 53%, 35% and 12% respectively. Severity of VFD in Patients with Diabetes and Hypertension according to severe, moderate and mild was 7.3%, 4.5% and 0.8% respectively. The p-value was 0.0046. **Conclusions:** Glaucoma patients with HTN, DM, or both were found to have more severe. Patients with these risk factors could represent "high-risk patients" with glaucoma. Patients with HTN and DM, or both may require evaluations on a more frequent basis to access the progression/severity of Glaucoma.

Keywords: Normal-tension glaucoma (NTG), Primary Open-angle glaucoma (POAG), Neuropathy, Intraocular pressure (IOP)

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Introduction

The second most common cause of blindness in the world is glaucoma. [1]The optic nerve sends visual signal from eye to brain and is integral for desirable vision. Damage to the optic nerve is usually associated to excessive intra ocular pressure in eyes. But glaucoma can occur even with ordinary eye pressure. It is a foremost international issue, inflicting substantial ocular morbidity and incapacity due to its innovative nature ensuing in an irreversible visible loss.[2]Patients are generally asymptomatic till very earlier stage, making visible loss irrecoverable end stage.[3]one of its variations and the most common primary open-angle glaucoma (POAG) is a chronic, progressive optic neuropathy that is related with attribute cupping and atrophy of the optic disc, visual field loss, open angles, and no apparent causative ocular or systemic conditions. [4]POAG accounts owed for almost three quarters (74%) of all glaucoma cases. [5]Various estimates and meta-analysis records exhibit that estimated there may want to be 60,500,000 humans with open-angle glaucoma and angle-closure glaucoma (ACG) in 2010. [6]Though it has many recognized microvascular complications, imaginative and prescient loss from diabetic retinopathy is one of the most

devastating for affected individuals. In addition, there is growing evidence to recommend that diabetic patients have a larger hazard for glaucoma as well.[7]Though the pathophysiology of glaucoma is now not totally understood, each diabetes and glaucoma show up to share some frequent hazard elements and pathophysiologic similarities with research also reporting that the presence of diabetes and expanded fasting glucose levels are related with multiplied intraocular strain the major hazard issue for glaucomatous optic neuropathy. While no learn about has absolutely addressed the opportunity of detection bias, latest epidemiologic evidence suggests that diabetic populations are in all likelihood enriched with glaucoma patients.[8]As the affiliation between diabetes and glaucoma turns into higher defined, activities contrast for glaucoma in diabetic patients, especially in the telemedicine setting, may additionally come to be a reasonable consideration to reduce the chance of imaginative and prescient loss in these patients.

DM and POAG are thought to have a direct relationship. Several theories on relation amongst DM and POAG have been proposed. The presence of long-standing hyperglycemia alongside with dyslipidemia can also make bigger the hazard of neuronal harm from oxidative stress.[9]Various investigations have likewise confirmed that diabetic eyes have a diminished capability to auto regulate blood go with the flow and exhibit diminished retinal blood flow.[10]

Ciccone et al have described the impact of increased sugar levels or insulin resistance in pre-diabetic patients with a robust record of DM in the family.[11]Various biochemical pathways and cascades are concept to be activated inflicting endothelial dysfunction eventually main to dysregulated vascular flow.

Systemic hypertension (high blood pressure) has been extensively studied as a potential risk factor for primary open-angle glaucoma (POAG). Hypertension may influence ocular blood flow and alter the dynamics of aqueous humor production and outflow, thereby potentially affecting intraocular pressure (IOP).[12]It has been hypothesized that chronically elevated blood pressure may contribute to increased IOP and reduced perfusion of the optic nerve head, which could promote glaucomatous optic neuropathy.[9, 13]

However, this relationship is multifactorial and remains somewhat controversial. While several epidemiological studies suggest a positive association between systemic hypertension and increased risk of POAG,[10, 14]others highlight that low systemic blood pressure—particularly nocturnal hypotension—may pose an even greater risk to optic nerve perfusion and glaucomatous progression.[15, 16]

This suggests a complex interplay between systemic blood pressure, ocular perfusion pressure, and optic nerve health. Therefore, maintaining blood pressure at an optimal level, and understanding this vascular-ocular interaction, is essential for the early identification and management of individuals at risk of glaucomatous damage related to systemic hypertension.

Subjects and Methods

Study Design

This observational cross-sectional study was conducted over a 12-month period, from January 2022 to December 2023, at BNSB Zahurul Haque Eye Hospital, Faridpur, Bangladesh.

Place of Study

The study was conducted at BNSB Zahurul Haque Eye Hospital, Faridpur, Bangladesh.

Study Population and Sampling Technique

The study population consisted of 80 patients, selected based on patients diagnosed with glaucoma who had no other co morbid conditions such as patients with secondary glaucoma (such as neovascular, uveitic, traumatic, or steroid-induced types), those with ocular co morbidities affecting the optic nerve or intraocular pressure (including optic neuritis, retinal vein occlusion, advanced cataract, or high myopia over 6 diopters), individuals with uncontrolled systemic conditions like poorly managed hypertension or diabetes, patients with poor compliance to prescribed anti-glaucoma medications, and those with incomplete clinical records or missing essential data were excluded from the study. The medical ophthalmologist and the physician were primarily involved in the decision-making process. The choice of treatment was made by the patient after a full discussion with the multidisciplinary team consisting of medical ophthalmologist and the physician. Ocular examination of the cases was done in Retina department of the hospital. History taking and best corrected visual acuity was recorded, intra ocular pressure was measured, and detailed examination of the ocular anterior and posterior segment was done. The pupil was dilated using tropicamide for indirect ophthalmoscopy with a 20-diopter lens. A color fundus photograph was also taken to aid in further evaluation and to serve as a reference for monitoring disease progression. Anterior and posterior segment examinations were performed using a slit lamp and with the aid of a 90 diopter lens respectively. Hypertensive retinopathy was graded keith and wagner classification. Diabetic retinopathy and macular edema were classified on the basis of Early Treatment Diabetic Retinopathy Study (ETDRS). Other investigation was done according to need like, 1. Flurescein Fundus Angiography (FFA), 2. Optical Coherence Tomography (OCT), 3. Goldmann Applanation tonometry.

Study Procedure

Data collection was conducted through clinical examinations and laboratory investigations. All participants underwent a detailed medical history review, clinical examination, and relevant diagnostic tests, including imaging studies where necessary.

Statistical Analysis

Data were analyzed using SPSS version 27 (SPSS Inc., Chicago, IL, USA). Descriptive statistics, including frequency and percentage for categorical variables, were used to summarize the data. Results were presented in tabular and graphical formats for clarity.

Ethical Considerations

Informed consent was obtained from all participants, ensuring they understood the purpose, procedures, risks, and benefits of the study. Participants were informed of their right to withdraw from the study at anytime without affecting their treatment.

Results

This observational study was conducted among previous and newly detected Glaucoma Patients by Hypertension and Diabetic individuals attending the outpatient department of BNSB Zahurul Haque Eye Hospital, Faridpur, Bangladesh, after fulfilling the exclusion and inclusion criteria by purposive sampling method. A total of 80 apparent patients were included in the study.

Table I: Baseline distribution of the study. (n=80).

	n (%)
Age Distribution	
20-29	9 (11.25)
30-39	13 (16.25)
40-49	17 (21.87)
≥50	41 (50.62)
Sex Distribution	
Male	42 (51.87)
Female	38 (48.13)
Co morbidity	
DM	47(58.75)
HTN	65(81.25)

Table I demonstrated the age of 80 Patients aged <20 to ≥50 years. Here according to Age distribution, 9(11.25%) were 20-29, 13(16.25%) were 30-39, 17(21.87%) were 40-49, and 41(50.62%) were ≥50. The total study population was 80 patients, according to gender 42(48.13%) were Male, 38(51.87%) were Female.

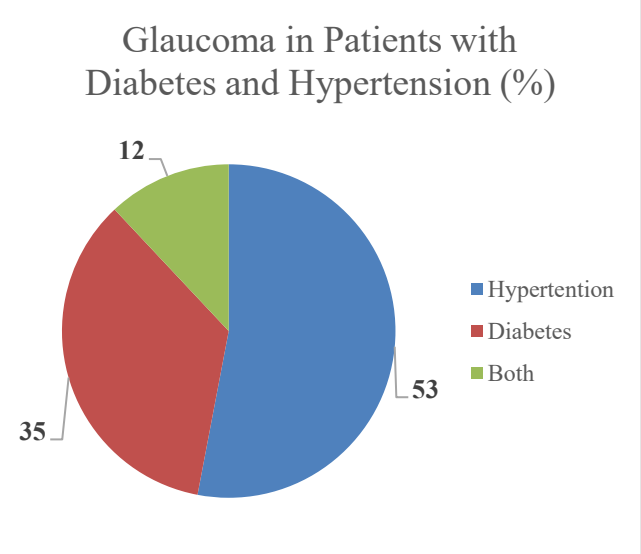

Figure I: Glaucoma in Patients with Diabetes and Hypertension

Here Hypertension, Diabetes and both were 53%, 35% and both 12%.

Table II: Ocular findings of Glaucoma in Patients with Diabetes and Hypertension

Ocular findings of Glaucoma	Mean	95% CI	
		Lower	Upper
Intraocular pressure (IOP)	16.0	13.9	18.0
Humphrey visual field analysis (HVFA)	-9.08	-16.9	-1.27
cup–disc ratio (CDR)	0.68	0.57	0.79

CI (Confidence Interval)

Table II demonstrated the Ocular findings of Glaucoma in Patients with Diabetes and Hypertension. Here according to Patients with Diabetes and Hypertension, the mean of Intraocular pressure (IOP), Humphrey visual field analysis (HVFA) and cup–disc ratio (CDR) were 16.0, -9.08 and 0.68 respectively.

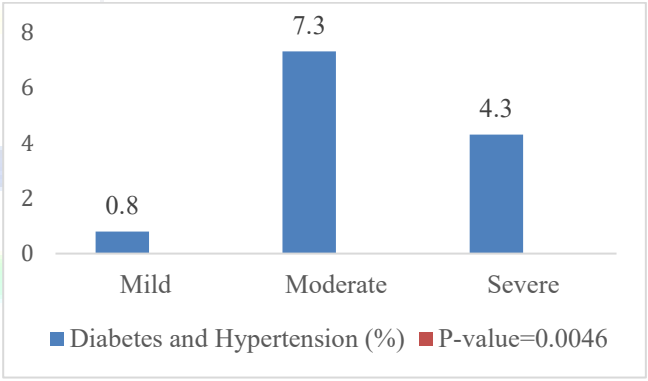

Figure II: Severity of VFD in Patients with Diabetes and Hypertension

Figure II demonstrated the Severity of VFD in Patients with Diabetes and Hypertension patients (n=80).

Severity of VFD in Patients with Diabetes and Hypertension according to severe, moderate and mild was 7.3%, 4.5% and 0.8% respectively. The p-value was 0.0046.

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Discussion

Among vascular factors, it has been lengthy postulated that systemic HTN may additionally motive will increase in IOP basically by means of overproduction from Ciliary body or impaired outflow of aqueous humor. [17]However, this relationship stays inconclusive and beneath debate. While some research spotlight that systemic HTN is a risk factor for glaucoma. [18, 19]different research points out that low systemic BP is extra hazardous and poses a serious risk for the improvement and development of glaucoma. This study found that, according to age of 80 Patients aged 20 to 60 years. Here according to Age distribution, 6(3.74%) were <20, 12(7.5%) were 20-29, 26(16.25%) were 30-39, 35(21.87%) were 40-49, 53(33.12%) were 50-59 and 28(17.5%) were ≥60. And according to gender 77(48.13%) were Male, 83(51.87%) were Female.

The inclusion standards for our contributors have been identified case for HTN and below medication. Earlier it used to be hypothesized that multiplied BP may be protecting in opposition to POAG, however He mentioned that it used to be only an acute BP elevation, which makes retinal feature and blood go with the flow much less susceptible to IOP.[20]The extended ocular perfusion pressure to compensate for the acute rise in IOP is compromised after four weeks of HTN. Chan et al. [21]additionally pronounced that patient with cardiovascular sickness had been instances greater probably to strengthen unexpectedly innovative glaucoma disease significantly lower mean and baseline IOPs.

DM is a serious and an increasing number of ordinary health difficulty global due to growing old populace and way of life changes. The occurrence of DM global was estimated to be 2.8% in 2000 and is forecasted to be 4.4% in 2030. [22]Some research additionally discovered that DM has a strong link with POAG. This relationship, however, nevertheless stays controversial. [23]

This study also showed that, the Ocular findings of Glaucoma in Patients with Diabetes and Hypertension. Here according to Patients with Diabetes and Hypertension, the mean of Intraocular pressure (IOP), Humphrey visual field analysis (HVFA) and cup–disc ratio (CDR) were 16.0, -9.08 and 0.68 respectively. Blue Mountains Eye Study. [24]supplied essential records of a complete populace who underwent an exact eye examination to set up an analysis of glaucoma or ocular HTN. The OR for glaucoma in diabetic patients in contrast with these besides DM used to be 2.12 (95% CI: 1.18 to 3.79). This was once one of the first research to set up a relationship between glaucoma and DM. The Baltimore Eye Study. [25]which was once performed comparable to the Blue Mountains Eye Study, additionally suggested age-race adjusted OR of 1.03 (95% CI: 0.85 to 1.25). But neither learn about describes or correlates if the severity of POAG is extra with DM.

However, Toda and Nakanishi-Toda. [26]reported about a direct relationship between DM and POAG, which should assist guide our result. A few theories on relation amongst DM and POAG have been proposed. There is a growing assortment of affirmation that long-standing hyperglycemia, alongside lipid abnormalities, may additionally amplify the hazard of neuronal injury from oxidative stress.[27]Data from more than a few laboratories have provided strong evidence for such an association.[28]

Another theory postulates that in diabetic eyes, there is redesigning of the connective tissue of the optic nerve head. This may decrease compliance at the trabecular meshwork and additionally in the lamina cribrosa, ensuing in extended IOP and improved mechanical stress on the optic nerve head.[29]Research has proven that DM can decontrol connective tissue redesigning and enlarge these biomechanical changes.[30]A systematic evaluation and meta-analysis with the aid of Zhoum et al have additionally concluded that though the precise mechanism of how the DM and POAG is nonetheless below debate, their meta-analysis consequences exhibit a considerable affiliation between DM and the risk of POAG.[31]Patients with DM had about 1.4-fold elevated risk of creating POAG in cohort research whilst the case manipulate research had almost 49% elevated odds of developing POAG compared with individuals without DM.This study found that, according to the Glaucoma in Patients with Diabetes and Hypertension patients (n=80) the Hypertension, Diabetes and both were 53%, 35% and both 12%. And according to Diabetes and Hypertension, Moderate and Mild were 11.8% and 0.8%. And P value were 0.0046.

In a study achieved by means of Shakya-Vaidya et al, [32] a robust affiliation between POAG and DM (OR 3.15) used to be demonstrated. They concluded that their consequences recommend that POAG series positively with HTN and DM in all ethnic groups. Newman-Casey et al – pronounced in one their study with 2,182,315 enrollees who met the inclusion criteria, 55,090 (2.5%) had POAG.[32] After adjustment for confounding factors, these with DM or HTN by myself or in mixture had an increased risk of creating POAG relative to people with neither of these conditions. They additionally suggested that human beings with DM alone had a 35% accelerated danger of creating POAG and these with HTN by myself had a 17% improved risk. For human beings with each DM and HTN, there was a 48% accelerated danger of creating POAG.

Conclusion

HTN and DM or each had a greater extreme structure of glaucoma when in contrast with the members besides these risk factors. Patients with these risk elements may want to signify “high-risk patients” and need to be recognized and be defined about the condition. A well documentation of the preceding investigation is an ought to analyze the rate of development and modification in the therapy may additionally be required accordingly. The patients need to be made conscious of the more than a few risk elements they might also have, which might also alter the direction of the disease. They have to be advised/recommended involving the requirement of evaluations on a greater regular basis to get right of entry to the progression/

severity of glaucoma.

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